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The Thirty-fourth Annual Report

of the

UNIVERSITY OF MARYLAND

Agricultural Experiment Station

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College Park, Prince George County, Maryland.

1920-1921

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Published by the Station

The University of Maryland
Agricultural Experiment Station

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The Station is located on the B. & O. R. R. and City and Suburban Electric Car Line, eight miles north of Washington, D. C.

Bell Telephone—Berwyn Exchange.

Visitors will be welcomed at all times, and will be given every opportunity to inspect the work of the Station in all its departments.

The Bulletins and Reports of the Station will be mailed regularly, free of charge, to all residents of the State who request it.

ADDRESS:
AGRICULTURAL EXPERIMENT STATION,
COLLEGE PARK, MD.

The Thirty-fourth Annual Report

of the

UNIVERSITY OF MARYLAND

Agricultural Experiment Station

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The UNIVERSITY OF MARYLAND

AGRICULTURAL EXPERIMENT STATION

Volume 34 1920-1921

THE THIRTY-FOURTH ANNUAL REPORT OF THE MARYLAND AGRICULTURAL EXPERIMENT STATION.

FOR THE FISCAL YEAR ENDING JUNE 30, 1921.

By H. J. PATTERSON, Director

To the Governor of Maryland and The President and Board of Trustees of the University of Maryland.

GENTLEMEN:—I submit herewith a report on the progress of the investigational work conducted by the Agricultural Experiment Station of the University of Maryland for the fiscal year ending June 30, 1921. This report is required by the Federal law and its purpose is to indicate briefly how the Federal and State appropriations for investigational work have been utilized. The report covers only the work in progress or completed during the past fiscal year together with some suggestions for extending and improving the work so as to increase its usefulness to the farmers of Maryland.

The Agricultural Experiment Station is the recognized center and source of agricultural information. Since the Establishment of the Experiment Station by act of Congress in 1887 a corps of workers have carried on investigations on the important problems which have confronted Maryland farmers, and have obtained results which have helped many farmers to procure a greater profit from their laborers and which have greatly advanced the agriculture of the State.

It has been the aim of the Station Staff to work in close cooperation with the farmers of the State and to deal with practical problems. The investigations conducted with soils, fertilizers, wheat,

corn, hay, forage crops, tomatoes, cabbage, potatoes, tobacco, strawberries, apples, peaches, hogs, poultry, and dairy cattle have yielded results that are returning to the farmers of Maryland many times the annual expense of the Station work, and the annual value of some of the work more than equals the entire cost of the Station since its establishment 32 years ago. The Maryland Agricultural Experiment Station invites a larger interest in its work on the part of all citizens and particularly the farmers. The Station is supported by State and National funds and its business is to serve the people and promote Agriculture, the largest undeveloped Natural resource of Maryland. The only limitation as to the service which the Station will be able to render is determined by the amount of funds available for its work. The Citizens of the cities and towns of the State are concerned as to this agricultural development, as it directly influences their food supply. Maryland farms are fortunately located with reference to markets and the soils are peculiarly suited to the growing of products for human consumption. The ultimate development of Maryland agriculturally, will be largely towards the production of foods. Appropriations for investigations must be regarded as investments, not expenses, burdens or gifts.

What the Experiment Station is doing for the Farmers.

Progress of Investigation.

Soil Resources: The Experiment Station in cooperation with the U. S. Bureau of Soils and State Geologist has made a classification of all the soils in the State and surveyed the State so as to determine the distribution and area of each class. The survey of all the Counties has been completed except Garrett. The survey of this County should be completed during 1922. On the completion of the soil survey the Station will be able to make an inventory of the soil resources of Maryland and make recommendations for the management of the different soil types based upon the results of the fertilizer and rotation tests in progress in different parts of the State. The Station has soil management and fertilizer investigations in progress in nine Counties on the predominating soil type of each County. This work involves keeping the record of 769 separate plats. The results obtained in this work would justify its extension so as to reach every County and all the soil types. If the farmers of St. Mary's County would apply the information gained from the tests made on the principal soil type of that County it would increase the production in that County by 400,000 bushels of corn, 170,000 bushels of wheat, 1,600 tons of hay and 3 million pounds of tobacco. An Examination of Maryland farm lands would

indicate that at least seven acres out of every ten are acid, and should be limed in order to get the best yields.

Grain Crops: The staple farm crops of Maryland, cereals, forage and tobacco, represent about 67% of the total annual crop value. It is evident that investigations with these crops will always command the major interest of the farmers.

Corn: Tests of corn have shown that the varieties best suited to Maryland are Johnson County White, Boone County White, Reids Yellow Dent and Funks Yellow Dent. Maryland grown seed of these varieties have given better yields than seed from other States. The highest yields of silage has been procured from Cock's Prolific and Eureka. They have given 5 to 8 tons more silage per acre than other varieties.

Wheat: The Experiment Station has tested 160 varieties of wheat. The best five varieties on test now will yield over 20% more than the best five of 30 years ago. A survey of the wheat fields of the State indicates that about 70% of the acreage is planted to the higher yielding varieties which were introduced by the Experiment Station. On this basis, the Station work has added about 1½ million of bushels of wheat to the annual yield.

Soy Beans: The Station began growing soy beans in 1889. During this period many varieties have been tested, but so far only 15 have been found adapted to Maryland conditions. Of these the varieties known as Virginia and Wilson are outstanding for yield and dependability.

The Station has in progress experiments in crop rotation, green manure crops, rates of seeding crops, plant selections for yields and resistance to disease, plant breeding, hay, pasture and lawn mixtures, and top dressing and fertilizing tests all of which promise very useful and valuable results.

Tobacco: The studies in fertilizing and rotation for tobacco farms have given exceptionally marked and valuable results. The continued work with the Maryland Mammoth tobacco, which was originated by the Experiment Station, has shown it to be one of the best varieties for Maryland conditions. It has given the highest yields and sold for the highest price of any raised in the State during the past three years.

Orchard Fruits: The importance of fruit growing in Maryland can be gained from the fact that there are over 3 million fruit trees growing in the State, and the annual sales represent about 10% of the total crop values. The Station has some very important investigations under way on orchard fertilization, cover crops for orchards, pollination of orchards, factors influencing biennial bearing and rejuvenation of orchards. The results on rejuvenating an

old peach orchard show that the work when properly done will make an orchard over in one season, and put it in shape to give profitable yields the next year.

Several promising early apples have been secured from the breeding work. The results in grape training indicate that the three wire Kniffin system is best for Maryland conditions. The breeding work with grapes gives promise of a good early dark colored grape, especially suited to Maryland.

Small Fruits: Work is in progress in testing varieties, culture methods, and effect of fertilization on strawberries, raspberries, blackberries and some other bush fruits. The freeze the past spring destroyed this year's crop.

Market Garden Crops: The annual returns from market garden crops represents about 18% of the total value of all crops grown in Maryland, or in other words about twice as much as the orchard fruits. Tomatoes, Irish potatoes, sweet potatoes, cabbage, sweet corn, spinach, cantaloups and asparagus have been given a prominent place in the market garden investigations. Special attention has been given to the development of disease resistant strains, or varieties of these crops, but this investigational work has also included studies of cultural methods, fertilization, crop rotation, tests of varieties, etc. Considerable work is in progress on studying available substitutes for stable manure for fertilizing market garden crops. The disease resistant strains of tomatoes which were developed at this station has been of great value to the canners of the State. This means much when it is remembered that Maryland packs about 45% of the output of the United States. Much progress has been made in developing disease resistant strains of cabbage and cantaloups.

The fertility studies have shown that market garden crops respond favorably to application of lime and that many of the ideas as to this class of crops preferring acid soils are erroneous. The value of lime for sweet potatoes and spinach has been particularly marked. Results would also indicate that many of the soils used for market garden crops are especially deficient in available potash. The growing of seed for market garden crops has received attention particularly with cabbage, cauliflower, cantaloups, peas and sweet corn. Results would indicate that specially selected home-grown seed has enough merit to make this project worth while. Storage problems are being studied with onions, potatoes and fruits.

Floriculture: Much work is being done with flowers which should be a benefit to both commercial and pleasure growers. The following are a few of the problems receiving attention: Factors which influence the splitting of the calyx of carnations. The use of artificial (electric) light to give a longer day in winter has hastened the blooming of snapdragons and lupines. A study of the influence of

the kind of bed, and under-drainage on green-house chrysanthums, and sweet peas, cultural and fertilizer studies in growing carnations and roses. Improvement of varieties by selection of stock and soil.

The Station has established in cooperation with the American Dahlia Society a test garden at College Park. The unusual weather conditions were very unfavorable for this work during the 1921 season.

Plant Physiology: Many of the problems connected with the growth of plants, the disease of crops, insect attacks of crops and the factors influencing the ripening, storage and conservation of fruits, vegetables and grains are dependent upon the physiological and chemical conditions and changes. These are the factors which are receiving the attention of Station Specialists in plant physiology. The results obtained in connection with seed potato investigations should greatly increase the average yield, and be worth large sums to the growers of this crop. The investigations on sweet corn should help the canners to improve the quality of their product, and make it more salable at better prices. This department is also making investigations of the nutrition requirements of the potato, spindling sprout disease of potato tubers, potato mosaics, factors influencing the maturity of potatoes, and factors influencing the hardiness of peaches.

Plant Diseases: The loss to farmers from crop and fruit diseases each year amounts to enormous sums, and methods for their prevention and control are important factors in his work. The following diseases have received the special attention of the plant pathologist during the past year: Fruit rots, corn root rot, fungi in corn ears, seed diseases, tomato blight and pear root rot. The breeding of disease resistant varieties and strains has received much attention as this seems to be a profitable field for research as the results are easy for the farmers to put in practise, and they are complete and far reaching. The welt resistant tomato strains developed by the Pathologist of the Maryland Experiment Station are now on the market, and used in several States, and are producing for agriculture annually many thousand times the original cost.

Insect Control: The importance of protecting crops, fruits and animals against insect ravages is impressed upon farmers every year. The farmers who practise the control methods advised by the Entomologist saves thousands of dollars in crops, and the farmers who fail to spray lose much. The Station Entomologists are working on the following problems: Control of Peach Tree Borer, Control of the Boxwood Leaf Miner, Control of the Chrysanthemum Gall Midget, Control of mealy bug, red spider, thrips, aphids, and scales in the Green house. Comparative value of sulphur com-

pounds, nicotine preparations, cresote compounds, pyrethreum preparation, spreaders and adhesive insecticide, repelling stable flies, winter protection of bees. The results with the use of paradichlorobenzend for the killing and control of the peach tree borer would seem to indicate that a practical solution of this vexing question has been secured.

Animal Husbandry: There has been a very small amount of money available for investigating animal industry problems. Some of the projects in this field have become dormant, on account of changes in Station Staff. There is opportunity to do much to benefit and develop the live stock husbandry in Maryland, as soon as funds are provided.

Poultry Investigations: The following matters have received the attention of the poultry department: A study of the factors influencing egg hatching; A study of the sources and remedies of gape worms; The development of poultry methods and appliances; Test of the suitability of lime stone grit as a substitute for oyster shell and granite grit; Feed rations and problems; Poultry culling and its relation to profit and elimination of diseases. Much better facilities and more for maintenance expenses should be provided for the work in the interest of this important industry.

Hog Industry: The investigation with hogs has been confined the past year to questions which would give a better knowledge of methods for the control of hog cholera. A survey of hog raising in Maryland would indicate that cholera is the principal drawback to its profits and development. A preliminary report upon these investigations will probably be issued next year, but it will require at least three more years to complete the work outlined.

Biological Laboratory: In addition to the research work with hog cholera this laboratory has also made a careful study of gout in geese, and done much on black leg in cattle, and testing an ozoning machine as an auxiliary in ventilation. This laboratory has distributed during the year about 600,000 C. C. Anti-hog cholera serum to the farmers of the state, and prepared and distributed 1422 tubes of culture for inoculating legumes and about 32,000 C. C. tuberculin. This laboratory has diagnosed trouble with about 400 animals representing 10 different species.

Dairy Farming: Is one of the important industries in Maryland and many of the problems pressing for solution should be receiving the attention of our Station. The lack of funds has necessitated cutting down this phase of our work, some important projects are dormant, and nothing is available for new projects. A study of the cost of producing milk with cows kept and fed under varying conditions is being made. Also a study of the protein requirement of

growing heifers. Some breeding problems are also in progress. For a complete list of projects see 32nd Annual Report.

Publications

The Station's appropriation for printing is not sufficient to provide for publishing the results of investigations promptly.

There is also need of having money available for reprinting some bulletins, the original editions of which have been exhausted. The bulletins are sent free to all farmers in Maryland who request them. There are about twenty-thousand names on the Stations general mailing list. The Station also has special mailing lists so as to be able to send information to farmers interested in special crops. The Station issues from six to ten bulletins each year. The system of handling the printing by the State Purchasing Bureau has prevented the issuing of bulletins promptly the past year.

The following bulletins were issued during the fiscal year 1920-21:

1920	*Number*	*Subject.*	*Author*	*No. Pages*
July	237	Variety tests of Corn, Wheat & Soy Beans	J. E. Metzger	24
July	238	Seed Inspection in 1919	F. S. Holmes	30
Oct.	239	The Relation of Green House Pests to the Transmission of Geranium Leaf Blight	P. Garman	26
Nov.	240	Internal Fungus Parasites of Agriculture Seeds	C. C. Chen	30
Dec.	241	Annotated List of Halticini	A. B. Duckett	45
1921				
Jan.	242	A Comparison of Different Forms of Lime	A. G. McCall	10
April	243	Seed Inspection in 1920	F. S. Holmes	20
June		Thirty-Third Annual Report		

These bulletins made a volume of 186 pages for the year. The Station Staff have contributed numerous articles of a popular nature to the Agricultural papers, and many technical papers to scientific meetings and Journals.

Buildings, Land and Facilities

The present station buildings need considerable repairs which should be made at once, and these buildings do not provide as much room, or as good facilities as are desirable for the work in hand. The fire hazard is great with laboratory and investigational work. A new, fire-proof, modern and well equipped building should be provided for the Experiment Station work. All of the station departments need more men, more apparatus and other facilities in order to handle the problems confronting farmers, and give them the help they desire promptly. If the Experiment Station is to render the service which farmers justly expect, it should keep in advance with its investigations so as to be a real leader, and not

be trailing behind. The present station farm does not provide enough land for its requirements, and much of the land is not suited for new problems. The difficulty can be met in part by renting land in different parts of the state, but for some classes of work it is essential to have suitable land at the central station.

The Station Staff

The research staff of the Station has a total of 25 persons. Six of these devote their whole time to investigational work, and others give some time to College duties.

If much is to be accomplished by investigators, they should not be handicapped by duties that break up their time or take their minds off their investigations. The College should be provided with sufficient teachers to take care of its work without encroaching on the investigator's time, and the investigator's teaching should be limited to not more than 10 or 12 lectures per year to advanced students. The good investigator should be paid as much as he could earn in an executive or commercial position, so as to encourage him to remain and confine his energies to his investigations. This is the only policy which will give stability to investigational work, and make for that progress which its importance warrants. The employment of labor through the State Merit Board has caused delay and lowered, rather than raised the standard and quality of the labor personnel.

The changes in the Station Staff during the past two years has been confined to the assistant positions. These changes have not necessitated much change in policy or character of work. There are some projects which are dormant as positions vacated during the World War have not been filled as it has been found best to use the funds thus released to provide properly for the other work. R. S. Allen resigned to accept a position in the U. S. Department of Agriculture. G. R. Stuntz, Assistant Agronomist transferred to County Agent Work in the Extension Service, and R. Lee Sellman, Graduate of the University of Maryland class of 1919, was appointed to fill this vacancy. J. R. Haag resigned to accept a position at Pennsylvania State College. R. C. Towles resigned to engage in commercial work with the Virginia Carolina Chemical Co. E. V. Miller resigned to take up missionary work in China. J. P. Jones resigned to accept a teaching fellowship at Cornell University. S. V. Eaton resigned to take up post graduate work at Chicago University. W. R. Ballard transferred to the Extension Service.

Financial Condition

The decrease in the purchasing power of appropriations has made it necessary to allow many investigations to become dormant, and also made it impossible, except in a few instances, to meet the demands for new investigations. This condition has been unsatis-

factory for both Station workers, and farmers. The circumscribed uses which can be made of appropriations under present laws makes it difficult to provide for emergencies, and this coupled with delays and arbitrary times set for making purchases through the State Purchasing Bureau has been expensive of time and money, and had a tendency to dwarf the energy of the investigators, and lessen the efficiency of the Station as a whole.

The prosecution of investigational work to the best advantage requires latitude in the expenditure of funds, and necessitates that workers shall procure supplies and facilities quickly, and without being hampered with indirect and arbitrary methods of transacting business. The nature of investigational work makes it impossible to forsee all requirements long in advance. The appropriation for the Experiment Station should be made in a lump sum to meet the requirements of the estimated budget submitted and agreed upon. The details of the expenditures of the Experiment Station will be found in the report of the University Accountant.

FINANCIAL STATEMENT

MARYLAND AGRICULTURAL EXPERIMENT STATION

In Account With

UNITED STATES APPROPRIATIONS

DR.

	Hatch Fund.	*Adams Fund.*
To appropriations for fiscal year 1920-1921	$15,000.00	$15,000.00

CR.

By Salaries	$12,182.49	$12,712.36
Labor	826.35	286.50
Publications	412.00	
Postage and Stationery	3.49	36.32
Freight and Express		2.00
Heat, Light, Water and Power	178.27	659.82
Chemicals and Laboratory Supplies	55.23	459.84
Seeds, Plants and Sundry Supplies	489.56	196.99
Library	5.50	
Tools, Machinery and Appliances	32.11	48.09
Furniture and Fixtures	599.25	102.72
Scientific Apparatus and Specimens	158.35	348.87
Traveling Expenses		67.43
Contingent Expenses	.....	.....
Buildings and Land	57.40	79.06
Total	$15,000.00	$15,000.00

MARYLAND AGRICULTURAL EXPERIMENT STATION

In Account With

THE STATE APPROPRIATIONS.

DR.

	General Fund.	*Ridgely Farm.*
Receipts for year 1920-21	$35,981.89	$4,565.01
Cr. Bal. June 30, 1920		3,481.12
	$35,981.89	$8,046.13

CR.

By overdraft June 30, 1920	$ 286.20	
Salaries	15,291.56	1,620.00
Labor	5,908.87	1,341.29
Publications	201.41	
Postage and Stationery	307.96	127.78
Freight and Express	828.29	113.62
Heat, Light, Water and Power	1,091.54	20.93
Chemical and Laboratory Supplies	245.79	16.55
Seeds, Plants and Sundries	523.15	498.03
Fertilizers	497.00	331.58
Feeding Stuffs	4,808.88	
Library	300.99	95.40
Tools, Machinery and Appliances	3,428.79	1,475.92
Furniture and Fixtures	68.23	20.58
Scientific Apparatus	134.15	
Live Stock	237.52	91.90
Traveling Expenses	822.74	212.52
Contingent Expenses	269.70	122.70
Repairs	609.12	568.53
Rent	120.00	
Credit Balance June 30, 1921		1,388.80
Totals	$35,981.89	$8,046.13

MARYLAND AGRICULTURAL EXPERIMENT STATION

In Account with the following:

Dr.

	Soil Fund.	*Farm Fund.*
Receipts for year 1920-21		$18,432.99
By payment of loan	$10,000.00	

Cr.

By overdraft June 30, 1920	$ 6,296.04	$ 2,790.80
Salaries	1,387.50	100.00
Labor	516.37	14,621.43
Publications		362.62
Postage and Stationery	5.00	29.55
Freight and Express	2.21	366.41
Heat, Light and Power	32.42	347.93
Chemicals and Laboratory Supplies	.....	.....
Seeds, Plants and Sundries	583.03	680.15
Fertilizers	157.97	568.25
Feeding Stuffs	.....	2,548.53
Library	.....	.56
Tools, Machinery and Appliances	.....	499.56
Furniture and Fixtures	.....	4.85
Live Stock	.....	40.00
Scientific Apparatus	70.79	.....
Traveling Expenses	770.84	708.00
Contingent Expenses	.....	187.96
Repairs	.....	56.70
Balance June 30, 1921	177.83	.....
Totals	$10.000.00	$23.913.30
Overdraft June 30, 1921	.....	$5,480.31

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University of Maryland
Agricultural Experiment Station

Bulletin No. 237 July, 1920

VARIETY TESTS OF CORN, WHEAT AND SOY BEANS

By J. E. Metzger and Geary Eppley

Introduction

The Maryland Agricultural Experiment Station has conducted for many years tests on the relative yielding capacity of varieties of corn, wheat and soy beans. The purpose of these tests is to determine the adaptability of the most important varieties of these crops to the state with reference to climate, yield, quality, disease resistance and to prevent as far as possible confusion on the part of the growers because of the large number of trade names given to various strains of well known varieties. The data here presented cover the annual results obtained since the last report was made together with the average yields for the varieties during various periods of years and for the entire duration of the project. Frequently, varieties which give good results for a year or two develop objectionable features and have to be discontinued while others show inherent weaknesses from the beginning under Maryland conditions. It is for this reason that greater significance should be given to the values recorded in the average columns in the tables than to the performance of the variety during any particular year.

The descriptive portion of the bulletin is devoted mainly to a presentation of the management of the plots, the cultural practices employed, and to the methods used in securing the results here recorded.

MANAGEMENT OF THE FIELDS.

The plots on which the tests are conducted represent a three year three-field rotation in which the corn crop is followed by wheat, and the wheat is followed by a crop of mixed hay. The soil thus is covered during one of the winters by the wheat crop and during the

other two by the grass and legume mixture. This rotation is representative of the most usual practice followed in the State, except that the hay usually occupies the land for an additional year. In some sections, on land in a high state of fertility, two successive crops of wheat are grown. For the hay crop, which is seeded in August, there is used a mixture consisting of 6 pounds of Alsike clover, 6 pounds of Common red clover, 4 pounds of Alfalfa and 8 pounds of Timothy. The soy beans are grown on a series of plots separate from the main rotation.

The surface soil with the exception of one field is a clay loam. In one of the fields it varies from a fine sandy loam to a clay loam. The subsoil in each field is a stiff clay which through the use of tile is well drained. In general the fields represent a very uniform condition with respect to soil type and drainage, and are well adapted to the production of the small grains, corn and soy beans.

Each field is plowed twice during a rotation of the crops. The clover sod is turned under early in the spring and the land is disced frequently until corn planting time. Usually two or three discings is sufficient to prepare the corn stubble ground for the wheat crop. The wheat stubble land is plowed as soon as possible after harvest and allowed to settle well for the August planting of the mixture of legume and grass seed for hay. Deep plowing is practiced in preparing the fields for the corn and shallow plowing for the hay crop.

The best guide for determining the state of fertility of the fields used for the tests is the yields secured from year to year on the control or check areas. For corn the range is from 40 to 55 bushels with an average of nearly 50 bushels per acre. The wheat yields have varied from 20 to 32 bushels with a general average of 26 bushels per acre. The average yield of hay per acre, from two cuttings, is approximately 3 tons. In addition to the sod which is turned under once in the rotation there is applied 8 tons of stable manure per acre between the hay and corn crops. Three hundred pounds of a mixed fertilizer having an analysis of 2 per cent. of nitrogen (N), 12 per cent. phosphoric acid (P_2O_5), and 4 per cent. potash (K_2O)* is applied per acre before planting the wheat plots. The manure and fertilizer is always applied before planting and at right angles to the direction in which the plots are seeded to insure a uniform distribution.

The arrangement of the varieties in the tables is in the order of their average yields during the past 10 years, or in accordance with their total average if they have been in test for a shorter period. In addition they are grouped as high, medium and low producers. The latter arrangement is determined by dividing the difference between the highest and the lowest yields by four, substracting this quotient

* Potash was omitted in the 1918 and 1919 seedings.

from the highest to establish the range for the best kinds and adding it to the lowest to secure the limits of yields within which the poor varieties fall. Those classed as medium in yield occupy a position between these groups.

CORN.

Tests of varieties and strains of corn have been conducted continuously by the Maryland Agricultural Experiment Station since 1903. During this time the yielding power and adaptability of more than 80 distinct varieties and strains have been studied. In no other farm crop is the influence of the diversity of the soil, the type of farming and the variation in the climate of the state so marked as in this. Corn in Maryland is grown on soils which vary in type from sands to clay, on general farms as well as semi-truck and truck farms and in fields which vary from a few feet to 3,000 feet above sea level. If there is added to this the differences which are brought about by the fertility of the soil, the efficiency of the management and the seasonal variation in rainfall, it becomes evident why it has been the policy of the Station to do much of its corn investigations and breeding work co-operatively with the growers. The results given in the table of yields represent mainly the results with varieties and strains which have been developed on Maryland farms, and in general presents the progress made by these growers in developing corn which is reliable for their localities. However, a few of the varieties have been introduced by commercial seed dealers. From the latter list there is omitted all varieties which seem to be new in name only.

These tests form a part of the general rotation practiced on the variety test plots which is described under the heading "Management of the Fields." After the second crop of hay is removed there is applied stable manure at the rate of eight tons per acre. This is the only fertility measure given the corn crop. The plowing, which is done as early in the spring as possible, is at right angles to the direction of planting, and is to a depth of seven inches. By frequent discings the land is kept free of weeds and in a mellow condition. Usually, and especially if there has been an abundance of rain, the plots are harrowed with a spring-tooth harrow and leveled with a smoothing harrow before planting. If the plowing in the spring is delayed until a heavy growth of grass has been made, as has been the case in a few instances on account of rainy weather, the sod is thoroughly disced before plowing. This operation cuts and macerates the vegetable matter which in turn hastens its decay and also prevents a mulch being formed in the bottom of the furrow.

FIGURE 1—Corn varieties, showing method of labeling plots. Each plot consists of two rows.

Each plot consists of two rows 208 feet long. The corn is planted in hills three feet six inches apart each way, thus giving a total of 118 hills per plot. Every fifth plot is planted to the same variety as a check on the fertility and other inequalities of the soil. The variety used for this purpose is a rather large yellow corn which has consistently been among the highest in its yields. All plots are planted heavier than the required amount of corn. In the one set of plots the thinning is done to two plants per hill and in the other to three plants per hill. Separate records have been kept on each rate of planting, but the yields recorded here are the average of four plantings of a variety during each year of the test. The corn when received from the grower is graded and each size of kernel planted separately. Usually, sufficient corn is secured from a single grade to meet the needs. The ordinary corn planter with the checking device is employed in the planting. As far as possible large, vigorous growing, late varieties are planted side by side, and the smaller and shorter seasoned kinds are similarly grouped in order to prevent in part at least differences in yields due to the influence of the plants themselves.

The smoothing or spike-tooth harrow, with the spikes turned back at an angle of about 45 degrees to prevent the dragging of rubbish,

is used for both the first and second, and frequently for the third cultivations. The first harrowing precedes the emerging of the sprouting corn and the second is given after the plants are about two inches high. The effect of these two harrowings is very pronounced in that they greatly reduce the amount of subsequent cultivation required, lower the cost of cultivating the crop, keep the field free of weeds and the surface soil loose. If a third cultivation with the harrow is practiced it is done when the plants are three to four inches high and with the spikes set nearly straight to raise the harrow. There is little danger of breaking the plants in the last harrowing if the work is confined to the four to five hours of mid-day, and to clear days only. At this time the stems and leaves contain a minimum amount of water and will bear bending without breaking.

FIGURE 2—Derrick and basket used for weighing husked corn. A platform is substituted for the basket for weighing stover, hay and grain in the sheaf.

The corn of the silage plots is harvested when the kernels are in the glazed stage, and of the plots grown for mature corn when the

variety is fully ripe. The former is reported in the tables in tons per acre, whereas the latter is given in bushels of shelled corn. When cut the mature corn is placed in shocks at the end of the plots and husked after curing. From moisture determinations made on samples secured at husking and weighing time the net weight is calculated on the basis of number one corn, 14 per cent. moisture. By shelling this representative sample there is secured also the proportions of cob and kernel which factor is used in determining the total yield of grain per acre.

The varieties are arranged in the table according to the average yields for the three years ending in 1917. In addition there is given the average yields for the entire period of the test, the per cent. of shelled corn and the color of the grain.

VARIETIES OF CORN IN TEST SINCE 1915

TABLE I.

Variety	Yield in Bushels of Air-Dry Shelled Corn Per Acre and Tons of Stover Per Acre												% Shelled Corn	Color of Grain
	1915		1916		1917		1918		1919		Average			
	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover		
Munkhuysen	60.72	2.62	55.15	2.76	38.48	2.42	.....	.....	38.64	1.08	48.25	2.22	80.3	White
Radcbaugh's B. C. W.	49.90	2.13	59.82	2.85	36.98	2.59	60.20	1.70	35.65	1.14	48.51	2.48	82.0	White
Skipper	52.12	2.53	58.84	3.04	35.23	2.69	56.33	1.55	.....	.....	50.63	2.45	81.1	Yellow
Silver King	56.87	2.13	54.81	2.50	34.52	2.12	55.26	1.60	31.32	0.70	46.56	1.61	82.3	White
Thomas	56.29	2.61	52.91	3.34	34.10	3.06	54.87	1.92	44.68	1.36	48.57	2.46	79.8	Yellow
Massey's B. C. W.	54.33	2.07	45.70	3.00	38.08	2.57	58.23	1.98	.....	.....	49.08	2.40	79.3	White
Excelsior	53.78	2.51	48.95	2.87	35.24	2.73	56.81	2.21	35.16	1.64	45.99	2.39	79.7	White
Schallcross's J. C. W.	53.56	2.16	57.30	3.34	35.58	2.59	47.46	2.03	34.48	1.29	45.68	2.28	80.2	White
Giant Beauty	46.75	2.94	56.07	3.87	37.38	3.70	51.73	2.28	.....	.....	47.98	3.20	79.3	Yellow
Golden Gem	54.00	2.38	47.27	2.55	35.89	2.31	52.74	1.70	.....	.....	47.47	2.23	81.5	Yellow
Funk's Yel. Dent	48.96	2.27	50.43	2.76	37.09	2.20	51.81	1.54	31.67	0.79	43.99	1.91	83.8	Yellow
Funk's B. C. W.	51.57	2.19	47.42	2.54	34.30	2.19	51.84	1.45	38.33	0.99	44.69	1.87	81.5	White
Leaming	52.11	2.58	55.80	2.40	34.16	2.43	40.72	1.14	34.90	0.89	43.54	1.89	81.7	Yellow
Cocke's Prolific	.....	.....	60.76	3.58	30.58	4.57	43.25	2.71	36.38	1.89	42.74	3.19	78.2	White
Yellow Gord	.....	.....	.....	.....	33.34	2.26	48.54	1.16	.....	.....	40.94	1.71	83.9	Yellow

B. C. W.—Boone County White.
J. C. W.—Johnson County White.

The highest average yield produced in these tests is recorded for Skipper, a yellow variety which resembles somewhat in type the Leaming yellow dent, but is larger and more vigorous in its growth. The lowest average yield during the period was produced by Yellow Gord. The former, so far as is known, is no longer produced on any Maryland farm. This is also the case with Munikhuysen. Of the varieties which are still being grown and seed offered for the Maryland trade, the highest yields were obtained for Maryland Boone County White and Thomas. The Thomas, which is not so well known as the Boone County White, is a large yellow variety giving good yields of both shelled corn and stover, but is rather irregular in type, and low in per cent. of shelled corn. An examination of the annual yields since 1915 shows that no one variety has been in the lead during consecutive years, however, several of them have a constant tendency to be in the group of high yields. In fact, five of the fifteen varieties here reported may be classed as producing high yields, and only two as low yields. The average yield for the state is about 36.5 bushels per acre whereas the average for all varieties in the tests is 46.3 bushels. Even if a liberal allowance were made for a possible higher state of fertility in the soil used in the tests as compared with the average corn soil of the state, there remains sufficient margin in the yields to warrant the conclusion that the extra work and care required in the seed selection practiced by these growers is justified by the increased yields and profits secured.

Information is frequently requested on the use of seed produced in some distant state. These tests offer an opportunity to compare yields secured from crops grown from native seed, in one variety, with yields produced by crops grown from seed secured from the central west. Boone County White from local seed sources has been in test side by side with corn of the same variety purchased in Illinois. For the four years during which all three strains were tested there is an average difference of 5.4 bushels in favor of the Maryland seed in the one instance, and 2.9 bushels in the other. The chief difference in the strains is in the length of the ears. However the Radebaugh strain shows a greater depth of kernel than either of the others. The results obtained from the use of southern grown seed when planted in a northern climate of course is well known. The studies made in this project would lead one to conclude that there is enough difference in the yields obtained to justify advising against the use of seed which has been produced in some distant point in the same latitude, especially if there is any marked variation in the relative climatic conditions.

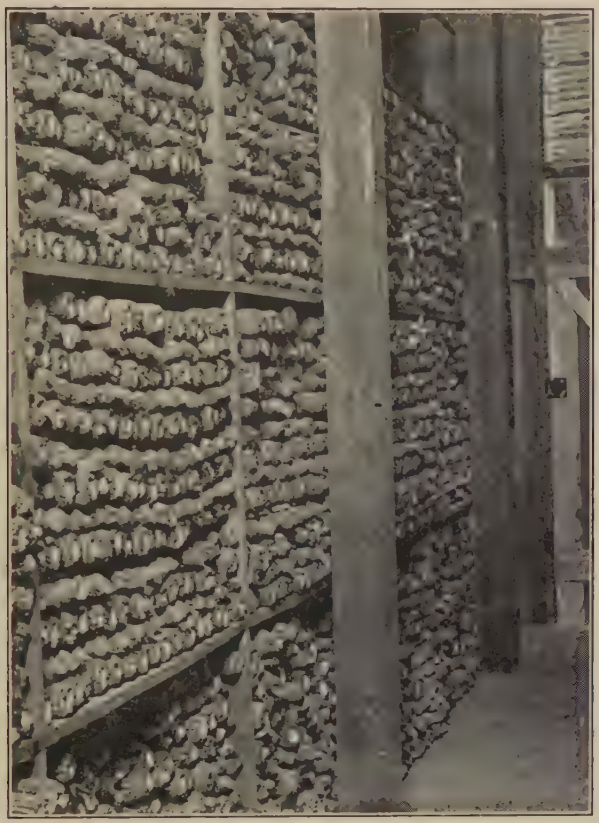

FIGURE 3—Drying racks for corn.

The question of using a special variety of corn for silage is one that has given the farmers of the state considerable concern during the past few years. In order to have some experimental data on the question there was begun in 1918 a separate series of plats in which there is used the principal corn varieties of Maryland in comparison with a well known silage variety, Cocke's Prolific. The seed for the silage corn is secured each year from a Central Virginia grower. The plantings are made in duplicate, and the varieties are harvested when the corn is in the glazed stage. All weighings are made at the time of harvesting the corn, and most of the varieties are shreaded and placed in the silo, however, some of the early maturing kinds have been fed green. The experiment has not proceeded far enough to justify giving definite conclusions, but from the data gathered

thus far it would seem to be a safe and desirable practice to use a larger growing variety for silage in all parts of the state east of the mountains. Where used the tonnage of fodder secured from the prolific varieties is not only larger than for the best of the local varieties, but there is also sufficient yield of grain as shown by our variety tests to give approximately the same feeding value. In addition there is less difficulty in shreading the corn on account of the smaller size of ears.

WHEAT.

The test plots used for wheat are 208 feet long and 12 feet (including alley) wide, giving a net area of one-twentieth acre. Each variety is planted in duplicate plots. Every fifth plot is planted to the same variety each year and their yields are used as a check on the variation in the fertility and other inequalities of the soil. The variety known as Fultz has been used for this purpose during the last 27 years. The first and last plots of each series are checks on the outside of which is planted a single drill width as a border to be discarded at harvest time.

FIGURE 4—Varieties of wheat bagged ready for seeding.

The seeding is done with a nine hoe drill at the rate of six pecks per acre. The drill is tested out each year to insure its proper adjustment. The order in which the varieties are planted is determined largely by the botanical characters of the mature plants. To facilitate the detection of mixtures gotten in handling the previous crop, as far as possible, bearded and smooth varieties are alternated. Another method practiced is to alternate white and red chaff varieties. With a few exceptions the planting has been done during the first week in October, and all of the plots seeded on the same day.

The original seed for the tests is secured from various sources. Some of it has been furnished by the United States Department of Agriculture, Bureau of Plant Industry; other varieties are gotten through exchanges made with experiment stations and still others from seed dealers and growers. The seed from each crop is saved and thus forms the source of supply for the succeeding trials. Wherever possible the serial numbers used by the Federal Bureau of Plant Industry are employed for additional identification. Each variety remains in the tests for at least three and usually five years. Unless they show qualities which are equal to or superior to the well established varieties grown in the state, they are then discontinued. A great many of the varieties which are secured under their trade names are found to be only renamed, well known, standard wheats. As soon as this fact is established their performance is compared with the proper records, and they are either discontinued or substituted for the old strain of the variety. A limited number of the varieties, as will be noted in the tables, have been continued in the tests for ten or more years. Some of them are new strains of the

FIGURE 5—Wheat plots, showing method of trimming ends and labeling plots.

old varieties, and all of them are well adapted to one or more sections of Maryland. They are kept in the tests either for comparison with their pedigree strains which are being tested, for further study of their adaptation, or for use in the development of new varieties by hybridization.

The areas devoted to these tests are slightly longer than the required length for a twentieth acre plot. This allows for removing a border before cutting, thus eliminating variations which would otherwise result in sources of error. The plots are harvested, as they ripen, with a grain binder and the grain is placed in shocks which are covered with canvass for protection against inclement weather and birds. Usually, from five to seven days lapse between the ripening of the earliest and latest varieties.

The threshing is done with a small size grain thresher. To save cleaning of the machine and mixing of the varieties as much as possible, the order of threshing the plots is determined by the character of the head which it possesses. All of the duplicate plots of a variety are threshed and as in the planting a smooth or colored chaff kind alternates with either a bearded or smooth variety. The records secured at threshing time are: the total weight of straw and grain per plot, the weight per measured bushel, and the moisture content of the grain. Corrections are made for excessive moisture, and for variations in soil type and fertility as indicated by the control plots. The final results are reported on the per acre basis in bushels of 60 pounds of number one winter wheat. This makes it possible to make a direct comparison of the annual yields with respect to both yield and quality.

FIGURE 6—Canvas covers are used to protect wheat against inclement weather and the ravages of birds.

The accompanying table gives the annual yields for each variety since the last report was made. The table includes also the Bureau of Plant Industry serial number for the variety, the character of the spike, the average weight per bushel, the average yield during the last ten years, and the average yield for the total number of years that each test has run.

TABLE II.

VARIETIES OF WHEAT IN TEST—YIELDS PER ACRE

NAME OF VARIETY	Record Number	Type and Color of Head (1)	Weight per Bushel	1917		1918		1919		1920		Four Year Average		Ten Year Average		Years in Test	Total Averg. Bu. Grain
				Bu. Grain	Tons Straw	Bu. Grain	Tons Straw	Bu. Grain	Tons Straw	Bu. Grain	Tons Straw	Bu. Grain	Tons Straw	Bu. Grain	Tons Straw		
HIGH YIELDS																	
Mammoth Red	2008	B W	58.50	24.70	.93	23.13	1.10	25.20	1.69	31.66	1.77	26.17	1.37	27.81	1.53	13	27.66
China	194	A R	57.49	26.51	1.08	19.41	1.20	22.20	1.60	29.58	1.69	24.43	1.39	27.51	1.62	13	28.20
Currell's Prolific (6)	89	A R	58.66	.....	.....	20.46	1.06	20.00	1.50	29.42	1.31	23.29	1.29	27.23	1.39	30	28.66
Turkish Amber	195	B W	59.13	27.37	1.19	20.78	1.11	22.60	1.65	28.21	1.65	24.74	1.40	26.99	1.51	13	27.71
Bearded Purple Straw (6)	1911	B W	59.19	.....	.....	15.69	1.19	23.40	1.70	28.10	1.29	22.40	1.40	26.95	1.65	13	27.09
Dietz Longberry	1981	B W	58.35	25.21	1.04	18.75	1.15	20.45	1.59	29.94	1.78	23.84	1.39	26.83	1.61	15	27.89
Fulcaster	352	B W	59.10	24.15	1.19	19.10	1.45	21.40	1.60	29.21	1.58	24.47	1.45	26.42	1.40	12	24.76
Bluestem (8)	1912	B R	57.60	23.45	.95	18.76	.91	20.75	1.48	.....	.....	20.99	1.11	25.94	1.37	12	26.16
MEDIUM YIELDS																	
Rudy	349	B W	58.83	22.70	.93	20.73	.80	18.90	1.42	28.01	.99	22.59	1.04	25.70	1.23	10	25.70
Mediterranean	1909	B R	58.10	24.28	.99	18.69	.88	19.50	1.51	26.82	1.41	22.32	1.20	25.52	1.48	13	25.58
Lancaster Red	1945	B W	58.85	26.60	1.08	19.36	.97	21.50	1.58	26.08	1.52	23.14	1.29	25.41	1.52	13	26.29
Gypsy	199	B W	58.85	22.84	1.09	20.75	.93	16.80	1.45	26.37	1.28	21.69	1.19	24.64	1.52	13	20.88
Dawson's Golden Chaff	1733	A R	56.03	20.49	.89	18.95	1.05	17.00	1.52	27.53	1.44	20.99	1.22	24.37	1.50	18	26.04
Fultzo-Mediterranean	1980	A W	57.80	26.30	.96	18.60	.72	20.50	1.41	25.13	1.49	22.63	1.15	24.10	1.26	13	24.73
Miracle (6) (7)	358	B W	58.64	.....	.....	19.16	.76	18.30	1.56	27.04	1.41	20.81	1.22	23.90	1.36	8	23.90
Jersey-Fultz (2) (8)	363	A W	59.10	24.60	1.03	18.57	.99	19.75	1.48	.....	.....	20.97	1.17	23.57	1.45	7	24.82
Fultz	84	A W	56.76	21.90	1.06	16.63	1.17	15.60	1.54	26.47	1.41	20.15	1.28	22.89	1.37	29	26.27
Gold Coin	353	A R	57.70	23.48	1.01	21.20	1.11	17.40	1.11	26.25	1.35	22.08	1.15	22.85	1.20	10	22.85
LOW YIELDS																	
U. S. Purple Straw (5) (8)	1916	A W	58.20	22.75	1.11	19.54	.84	18.00	1.41	.....	.....	20.10	1.12	22.44	1.40	9	23.06
Red Wave (4) (8)	351	A W	56.20	19.56	.91	.....	.....	.....	.....	.....	.....	.....	.....	21.99	1.15	7	21.99
Virginia Hybrid (2) (8)	3277	B W	58.30	19.52	.89	18.50	1.00	15.90	1.72	.....	.....	17.97	1.20	20.56	1.27	6	20.56

(1) A—Smooth, B—Bearded, W—White, R—Red.

(2) Not in Test Previous to 1913.
(3) Not in Test Previous to 1914.
(4) Not in Test in 1918-1919-1920.
(5) Not in Test in 1913-1914-1915-1920.
(6) Not in Test in 1917.
(7) Not in Test in 1912.
(8) Not in Test in 1920.

The factors used in determining the comparative value and adaptability of a variety in these tests are: First, its ability to yield well and consistently during a period of years; second, the milling quality of the product; third, its adaptability to the climate as indicated by the character and quality of the kernels and straw, the time of maturity and its resistance to severe temperature changes; fourth, the character of the spike with respect to the awns, its compactness and its tendency to shatter in handling; and fifth, its susceptibility to wheat diseases. In a study of the varieties with reference to all of these qualities, it was found that although their arrangement differed somewhat with each factor there was no wide variation from the grouping used in the tables. That is, the high yielding varieties are also the most desirable from other standpoints.

Doubtless, the soil on which these tests are conducted is higher in fertility than the average used for wheat in the state. At least this would seem to be the proper conclusion since the yields in all of the groups are well above those given in the crop reports for Maryland. Due allowance, however, should be made for the probable greater attention given in these tests to such factors as care in the preparation of the seed-bed, treatment of the seed before planting and the time of planting, all of which affect the stands of grain and yields secured. The wide variation in yields between the varieties listed in the first group and those of the second and third groups is too significant to be passed over without special attention. It is not a difference due to variations in soil conditions or inequalities in fertility because the areas used are selected on account of their general uniformity in soil type. In addition, all of the plots receive similar treatment and corrections are made for possible discrepancies through the use of control or check areas. If it is assumed that similar results would be obtained on other soil types—our demonstration tests indicate this—the variety used on any farm may well determine the difference between profit and loss in wheat growing.

It is probable that the great diversity of the climate between the eastern and western sections of the state due largely to differences in elevation, is the greatest factor in determining the relative value of a variety of wheat. At least, the rather common idea that the inferior results secured from some varieties in certain sections of the state is due to inadaptable soil type conditions is not well founded. Observations together with a limited amount of experimental evidence indicate that the late maturing varieties, most of which are bearded types, give better results in the western part of the state than they do in the eastern and southern sections. On the other hand, the early varieties which usually escape the extremely warm weather and the severe ravages of the wheat diseases are more satisfactory in the eastern and southern counties.

That wheat yields for the past three years, and especially in 1919, were below normal is evident when the annual records for this period

are compared with the ten-year and total averages. The sum of the average yields of the varieties in the first group for the last three years is 19.4 and 19.7 per cent., respectively, lower than the averages for the longer periods. Unfavorable climatic conditions and severe losses from wheat diseases have caused the decreased yields in recent years. These facts furnish additional evidence on the importance of using the longer in preference to the shorter intervals for determining the comparative value of a variety.

The five varieties producing the highest yield are: China, Currell's Prolific, Mammoth Red, Turkish Amber, and Bearded Purple Straw. With the exception of the Turkish Amber, these varieties have been in the lead in each of the ten years. However, they have exchanged places with each other in the order of their rank almost annually. The greatest difference between the average yields for these five varieties is slightly more than three-tenths of a bushel, an amount well within the range of experimental error for plot work. Of the eight varieties in the first group, all, except Turkish Amber and Blue Stem, are pure line strains which have been developed at this Station, and all of them seem to be constantly superior physiologically to the original varieties from which they were selected. From the standpoint then of yield there is no preference in this list of first group varieties. But if the type of plant, the time of maturity and the quality of the product are noted there is ample opportunity for the grower to make selections of varieties suitable for the climatic conditions of his locality.

TABLE III.

VARIETIES OF WHEAT TESTED FOR THE FIRST TIME AT THIS STATION COMPARED WITH HIGH YIELDING WHEAT

Name of Variety	Type and Color of Head (1)	1918		1919		1920		Average Yield	
		Bu. Grain	Tons Straw	Bu. Grain	Tons Straw	Bu. Grain	Tons Straw	Bu. Grain	Tons Straw
Mammoth Red	B W	23.13	1.10	25.20	1.69	31.66	1.77	26.66	1.52
China	A R	19.41	1.20	22.20	1.60	29.58	1.69	23.73	1.50
Kharkov	A R	22.60	1.20	19.10	1.85	28.63	1.35	23.44	1.47
Leap's Prolific.....	A W	13.37	.51	22.70	1.40	33.94	1.08	23.34	1.00
Jones' Climax	A W	24.20	1.21	18.10	1.99	23.67	1.31	21.99	1.50
Indiana Red Wave.	A R	15.70	.85	18.70	1.32	27.03	1.13	20.48	1.10
Kanred	B W	15.30	1.15	8.40	1.07	19.04	1.58	14.25	1.27

(1) A-Smooth, B-Bearded, W-White, R-Red.

The results secured with several new varieties which have been in test for three years are given in table III in comparison with the highest yielding bearded and smooth varieties for the same period. Of these new varieties both Kharkov and Leap's Prolific have produced yields that make them worthy of serious consideration for use in this state. Kanred thus far has been very unsatisfactory in that it produces under Maryland climatic conditions a very small head and exceedingly weak straw. In yield and quality of grain none of the new varieties could be classed as better than medium in our tests; although in other respects, except for Kanred, they are entirely satisfactory for this state.

SOY BEANS.

The Soy Bean or Soja Bean (Soja hispida) was grown on the Experiment Station farm during the first year of its organization. The Annual Report of the Station made in 1888 contains a record of the yields of one variety grown on 27 plots having a total area of three and three-eighth acres. This test seems to have been made to determine the qualities of the soy bean for forage purposes, and to ascertain the comparative productiveness of the plots on which they were grown. Two difficulties were encountered in this trial. First, the variety used required a longer season for maturity than was available in this particular year, and second, the plants were attacked by a disease which was called a blight, causing them to temporarily stop their growth. However, the desirability of the soy bean as a farm crop was apparent from the beginning and during the years that followed tests were made of its value as a forage plant, for green manure, and for silage purposes. The work of the station in securing varieties adaptable for both seed and hay production began in 1911. Since then more than 150 varieties have been in the tests and demonstrations and it is estimated that fully 10,000 acres of the beans are now grown in the State, annually.

The soil on which the soy beans for seed and hay are grown varies from a loam to a clay loam. The present rotation consists of soy beans followed by rye as a green manure crop. By discing the rye before plowing a thorough mixture of the soil with cut and macerated plants is secured which in turn insures prompt disintegration of the rye crop. The plowing is done immediately after the discing and to a depth of seven inches. All subsequent preparation given the soil before the planting is quite similar to that described for corn. In general the preparation of the land and the management of the crop to harvest time is quite similar to that practiced in growing corn. In addition to the green manure which is turned under for each crop, there is applied 200 pounds of 16 per cent. acid rock per acre.

FIGURE 7—Three types of soybean plants. Virginia on the right has small leaves and fine stems. Wilson has medium coarse stems and leaves. Taha has coarse stems and large leaves.

The seed test plots, which consist of single rows, are 208 feet long and 3 feet wide. Each plot has an area of nearly one-seventieth acre. In the hay variety tests the plots are one-twentieth acre areas, and are of the same general shape as the wheat plots. Duplicate plantings are made of each variety, and every fifth plot is planted to the same variety as a check or control. By use of planter attachments which are adapted to the shape and size of the beans, a uniform rate of planting is secured. The rate of planting for seed is two pecks and for hay six pecks per acre for varieties having seeds of the size characteristic of Virginia and Wilson. With larger varieties the seeding rate is slightly higher and for smaller varieties a proportionately less quantity is used. In seeding the increase plots the grain drill is set for seeding oats at the rate of six pecks per acre, and all except the two outside and the middle seed cups are closed. This spaces the rows 28 inches apart if a 9 hoe drill is used. A marker similar to that used on a corn planter is attached to the drill to insure uniform spacing. In planting the hay plots the drill is set as for oats at six pecks per acre, and with all of the cups open. The usual time of planting the plots is about May 20th to 25th.

Soy beans germinate and emerge from the ground in a few days. On this account it is rarely possible to give them any cultivation with a harrow after planting. They also seem to make very slow growth for the first few weeks. This makes it necessary to have the ground well prepared and free of weeds before planting the seed. The first cultivation is given the crop when the plants are about four inches high. Usually two additional cultivations are sufficient. The soy bean has a tap root with very few lateral roots which permits deeper cultivation without injury than can safely be practiced in managing a corn crop.

FIGURE 8—Varieties of soy beans showing different stages of maturity.

Soy beans have a blooming period which extends over several weeks. If the harvesting for hay is done when they have nearly finished blooming, when the first pods and seeds are fairly well developed and before the leaves have turned yellow, the maximum yield of high quality hay will be secured. As a result of some tests which have been made during the past few years, the hay plots are now harvested and the yields determined by taking samples from small areas in each plot. The total area covered by the small plot harvester is one five-thousandth of an acre. By removing ten samples at uniformly spaced points on the plots and comparing the calculated yields with those secured from the entire plot, it has been found that the two methods give approximately the same results. The small plot method has an advantage over harvesting the entire plot in that it is much faster, and that it makes it possible to harvest each variety at the proper stage of maturity. The seed and

multiplication plots, however, are not harvested until all of the pods have ripened and the leaves have dropped from the plants.

The common hay implements are used for handling the hay crop, and a grain binder for harvesting the seed plots. The hay is allowed to wilt in the swath and cure for a day or more in the wind rows after which it is placed in cocks. Usually, it is ready to be hauled to the barn on the third or fourth day after cutting. Less difficulty is experienced in threshing the mature beans without splitting them than is the case with other large seeded annual legumes on account of the small aperature between the cotyledons and their comparatively tough seed coat. By reducing the cylinder speed of the thresher to about 600 revolutions per minute and by substituting blank concaves practically no loss from split beans is sustained. If the soy beans are to be ground and fed to dairy cattle the threshing may be done without any regard to the amount of seed broken in the threshing. On farms where only a small acreage is produced for a home seed supply, it is a good practice to thresh the beans with a flail. Usually, about two weeks are necessary for the beans to cure thoroughly in the shocks.

FIGURE 9—Mowing soy beans for hay. The yield in this field was 3.5 tons per acre.

TABLE IV.

VARIETIES OF SOY BEANS IN TEST FOR SEED

Name of Variety	Record Number	Color of Seed	Seeds Per Ounce	Character of Stem (1)	Yield Per Acre (Bushels) 1917	1918	1919	Three Year Average	Total Average	Years in Test
HIGH YIELDS										
Virginia	32906	Brown	267	M 1	14.88	15.23	20.24	16.78	18.36	7
Edna	17252-C	Black	249	M 2	17.11	10.93	19.31	15.78	15.64	9
	19186-B	Black	348	F 1	14.68	16.22	16.17	15.69	17.26	9
	3253	Black	203	M 2	15.54	13.84	15.12	14.83	14.47	9
Flat King	17252	Black	241	M 2	14.72	13.49	16.40	14.87	14.27	9
	3691	G & Y (2)	159	C 2	18.44	9.65	16.41	14.83	14.68	8
Arlington	22899	Black	342	F 3	13.38	11.16	19.26	14.60	13.90	8
	1002	Black	275	M 1	17.08	7.67	18.56	14.44	15.44	7
Haberlandt	34924	Yellow	178	C 2	11.03	15.11	16.81	14.32	15.90	7
MEDIUM YIELDS										
Cloud	16790	Black	322	F 1	17.37	9.30	14.97	13.88	17.02	8
Peking	32907	Black	380	F 4	18.89	8.83	13.84	13.85	14.97	7
Wilson	19183	Black	279	M 1	12.17	11.63	16.52	13.44	14.68	7
Morse	19186	G & Y	171	C 2	17.13	10.12	12.21	13.15	13.69	9
Ebony	17254	Black	356	F 3	12.16	12.79	14.48	13.14	17.11	8
Swan	22379	Yellow	173	M 5	13.60	14.41	10.40	12.80	11.80	6
Meyer	17852	Black	370	F 4	10.93	14.65	12.62	12.73	14.59	8
	1844	Yellow	207	C 2	13.16	8.61	16.17	12.65	13.81	9
	1838	Yellow	184	C 2	11.84	7.50	17.80	12.38	13.68	9
Patuxent	1822	Yellow	173	C 2	13.06	11.27	11.46	11.93	13.62	9
	3267	Y & G	148	C 2	17.34	7.33	10.47	11.71	12.83	9
Medium Yellow	17269	Yellow	228	C 2	17.02	4.53	13.32	11.62	13.97	9
	30745	Yellow	180	C 2	10.24	8.84	15.70	11.59	12.54	5
Kentucky	.....	Yellow	197	C 2	11.31	9.07	13.09	11.16	11.27	7
	19183-7	Black	287	M 1	13.46	2.90	16.40	10.92	12.07	5
	1540	Yellow	218	C 2	10.57	6.57	15.47	10.87	13.21	5
Hope	17267	G & Y	113	C 2	7.22	9.42	15.18	10.61	12.96	9
Taha	21999	B & Y	121	C 2	12.24	11.98	7.44	10.55	13.23	8
	1857	Yellow	176	C 2	13.30	7.50	10.64	10.48	14.20	9
Ito San	33280	Yellow	175	C 2	15.89	5.25	10.00	10.38	10.10	7
	3765	Black	325	M 5	11.80	5.17	14.12	10.36	11.35	8
Wilson-five	19183-5	Black	402	F 1	14.24	7.97	8.70	10.30	11.35	5
	19183-9	Black	288	M 5	15.41	3.89	10.87	10.06	12.48	5
	1825	Y & G	149	C 2	12.94	7.50	9.71	10.05	12.71	8
	3689-AG	Yellow	185	C 2	2.92	12.56	14.54	10.01	12.61	8
Mammoth Yellow	.....	Yellow	177	C 2	6.87	11.75	11.28	9.97	9.94	8
	3562-AG	Brown	151	C 2	11.88	5.64	11.23	9.92	12.50	8
	17263-A	G & Y	155	C 2	7.17	7.85	14.66	9.89	12.86	9
	30598-A	G & Y	170	C 2	10.38	5.52	13.72	9.87	12.54	5
	3447	Yellow	253	C 2	12.16	3.17	13.14	9.49	13.62	8
	30599	Yellow	183	M 2	11.62	6.51	9.07	9.07	11.21	5
	1907	Black	318	F 1	10.52	6.57	9.88	8.99	11.88	9
	30478	B & Y	100	C 2	16.86	2.11	7.91	8.98	9.59	5
	19183-2	Black	237	C 2	13.11	7.92	4.94	8.66	9.09	5
	19183-1	Black	283	M 2	8.63	6.81	9.01	8.15	10.56	5
LOW YIELDS										
	24184	Yellow	148	C 2	3.35	5.00	15.07	7.81	11.36	8
	19183-3	Black	286	C 5	11.22	5.29	6.57	7.69	10.32	5
	U. S. 20409	Brown	692	F 5	9.70	1.69	6.86	6.08	6.08	3
	30596	G & Y	148	C 2	13.95	3.54	5.17	7.55	12.53	6

(1) M—Medium thick stem. C—Coarse stem. F—Fine Stem.
1—Twining. 2—Straight. 3—Vining. 4—Branching. 5—Slight Twining.
(2) G—Green. Y—Yellow. B—Black.

TABLE V.

VARIETY TEST OF SOY BEANS FOR HAY—
YIELD PER ACRE (TONS)

Name of Variety	Years in Test	Yield 1917	Yield 1918	Yield 1919	Three Year Average	Average For Years in Test
Ebony	6	4.25	2.41	4.97	3.88	3.76
Virginia	6	3.57	2.10	4.04	3.24	3.11
Cloud	3	3.65	2.06	3.70	3.14	3.14
Arlington	5	3.80	2.40	2.87	3.02	2.92
Peking	6	3.60	2.38	2.82	2.93	3.13
Wilson	6	3.70	2.32	2.55	2.86	2.78
3691	3	2.20	.....	.....	.....	3.46
1822	4	3.67	.....	.....	.....	3.10
Mammoth Yellow	2	.....	2.11	3.80	.....	2.96
Haberlandt	2	.....	2.49	3.17	.....	2.83
Edna	4	3.75	.....	2.00	.....	2.73
Morse	2	.....	2.00	3.00	.....	2.50
Meyer	2	.....	2.47	2.07	.....	2.27

As in the wheat and corn tests, the varieties are grouped according to their rate of yields into high, medium and low. This classification is made on the basis of the three year averages. With the exception of Wilson, Ebony, Arlington and Cloud, it applies equally well to the total averages for all of the varieties. If the longer periods were used in arranging the groups, Arlington would fall into the medium and the others named into the high yield group. Of the 48 varieties given in the table, 8 have yielded more than 14 and 4 less than 7 bushels per acre. The remaining 35 have produced amounts averaging between these limits and constitute the middle group.

Associated with the important aspects of the tests are the determination of the type and character of the plants, and a study of the adaptability of the varieties to Maryland's climatic conditions. Successful test crops of some of the most desirable varieties, as Virginia and Wilson, have been secured on the high altitudes of the Western sections of the state, and no crop failures for these varieties have been recorded for the lower altitudes or in the mountain valleys. However, varieties such as Mammoth Yellow and Hope, which are high producers in the South Atlantic and Gulf States, do moderately well in favorable seasons but frequently give low yields in our tests because the plants are killed by frost before all of the pods are matured. Others of the low yielding varieties of which number 20409 is an example do not make sufficient vegeta-

tive growth or produce enough seed to give them any commercial importance in this state or under similar seasonal conditions.

The factors to be considered in selecting a variety of soy beans for seed or hay are: Date of maturity, size of plants, coarseness of stems and branches, tenacity of the foliage and the yield of seed and hay. These characters are indicated for each variety in the tables, and when all of them are taken into consideration for a period of years the tests indicate that the best varieties for Maryland are: Virginia, Wilson, Edna, Cloud and Haberlandt. Virginia has headed the list consistently in seed production throughout the entire period of the test. Furthermore, it has a characteristic growth habit and seed color which makes it a distinctive variety for local use and one which is reasonably sure to mature in any year even in the western sections of the state. A variety which in a previous report was recorded as number 1822 has been very successful in certain sections of the Piedmont region, and has become well enough established to justify giving it a name. The new name for this variety is Patuxent.

The average number of seeds per ounce were determined for the 1918 and 1919 crops, and are given in the table in the column headed "seeds per ounce." Since this is based on the size of the seeds, it forms a rather accurate method for determining the rate of planting. For example Virginia has 267 seeds per ounce and practice has demonstrated that 30 pounds of the seed are required to plant an acre if grown in rows 28 inches apart and 90 pounds when drilled for hay. On this basis Mammoth Yellow should be planted at the rate of 42 pounds if grown for seed and 130 pounds for hay. These amounts are only slightly over the usual rate of planting practiced with these varieties.

FIGURE 10—Soy bean hay varieties curing in cocks.

SUMMARY.

The variety tests of corn and wheat form a part of a three-year rotation in which mixed hay is the additional crop. The soy beans are grown on a separate series of plots.

The text of this bulletin is descriptive of the management of the crops and the methods employed in securing the results reported in the tables.

The yields are given as high, medium and low; the classification being made on a numerical basis.

The variety tests of corn are in general a measure of the progress made by co-operative corn breeders in the state, together with a study of the adaptability of other varieties offered for the Maryland seed corn trade.

Larger yields of corn were produced from native than from seed secured in the same latitudes but from the central west.

The wheat yield averages are given for 4, 10 and total years of the tests. Some of the varieties are retained in test solely as controls for the wheat breeding and selection work of the station.

Of the five varieties giving the highest yields, two are smooth and three are bearded. These varieties have interchanged places frequently during the last ten years, but no other varieties have outranked them.

Soy beans were first grown at the Maryland station in 1888. An inquiry into their value for forage and soil improvement being the purpose of the test.

This report is a study of the adaptability of soy bean varieties for hay and seed. To date the leading varieties for Maryland are: Virginia, Wilson, Peking, Haberlandt and Patuxent.

UNIVERSITY OF MARYLAND—AGRICULTURAL EXPERIMENT STATION

Bulletin No. 238 July, 1920

WORK OF THE SEED INSPECTION LABORATORY FOR THE YEAR 1919

By F. S. Holmes.*

INTRODUCTION.

The principal work of the Laboratory for the year 1919 consisted of the following:

Inspection of the tagging and taking of samples of lots of seed held by retail dealers, and found in transit, throughout the State.

Making of purity analyses and germination tests of the samples collected.

Various work on samples submitted to the Laboratory by seed dealers, canners and farmers.

Because of the necessity for limiting the number of pages of this bulletin the detailed treatment of each sample, which it has been the

HOW DO THE SAMPLES OF THE DEALER FROM WHOM YOU BOUGHT YOUR SEEDS COMPARE WITH THOSE OF THE DEALER FROM WHOM YOU MIGHT HAVE BOUGHT THEM?

SEE TABLES I, II AND V.

custom to give in previous bulletins from the Laboratory, is omitted. It is believed, however, that the summaries, which are given instead, will answer the same purpose. Summaries which show the essentials necessary to an understanding of the character of the samples of the seeds sold by wholesale and retail dealers may be read in a short time and are readily understood. In order to give the retail seed dealers and the farmers of the State a more definite idea of the make-up of the mixtures of grass seed sampled during the year, the results of the purity analyses and the germination tests of these samples are reported in more detail than heretofore.

*The writer has been in charge of the Laboratory since September 1st, 1919. Prior to that time it was under the direction of Mr. C. P. Smith, who organized it in the fall of 1912 and was in charge of it continuously till the time of his resignation, September 1st, 1919. During these seven years he built up, from the foundation of a small appropriation and an inadequate seed law, a system of seed inspection work that is among the best in the United States.

The purity analyses and the germination tests from which the data for this bulletin were derived were made by Miss Anna M. Hook, Mrs. Clara R. Hodgins, Miss Caroline E. Veitch, and Miss Isabel C. Veitch.

INSPECTION OF TAGGING AND COLLECTION OF SAMPLES.

The tagging, of the seed stocks of practically all the known retail seed dealers of Maryland, was inspected during the year. Most of the retail seed dealers were visited twice and many of them three times. Samples were collected from lots of seed held by, or consignd to, 221 retail dealers who were located in Baltimore and 115 other points throughout all the counties of the State except Calvert, Charles and Saint Mary's. Samples were also collected from lots of seed consigned to 37 farmers.

A total of about 1,500 samples were collected. The results of the purity analyses and the germination tests of 1,455 are reported in this bulletin. The remainder were duplicates from very small lots or, for various reasons, of such a character that they were not thought of sufficient importance to justify their consideration.

PURITY ANALYSES AND GERMINATION TESTS OF COLLECTED SAMPLES.

Variations of Purity Analyses and of Germination Tests.

Purity analyses, or germination tests, only approximate each other when made in duplicate. The provisions of our seed law which specify that percentages shall "approximate" those on the tag required to be attached to all seeds are based on this fact. No samples which "approximate" their respective "given" analyses, or tests, are reported in this bulletin as "misrepresentations."

The word "approximate" of the seed law has previously been defined by this Laboratory in terms of definite variations. These variations were discussed in some detail in Bulletin 220 under the heading "Tolerances for Variations in Analyses and Tests." The tolerance tables of Bulletin 220 have been used as a basis in the preparation of the tables giving results of purity analyses and germination tests of samples collected in 1919. For the sake of clearness and accuracy of statement, the term "maximum tolerated variation" (M T V) previously used has been changed to "limit of tolerated variation" (L T V). "Found" percentages beyond the "limit of tolerated variations" are the only ones considered not to "approximate" their respective "given" percentages, and such samples are the only ones reported in this bulletin as "misrepresentations."

Benefit of Doubt Given the Dealer.

In case of doubt the dealer has been given every reasonable benefit. All samples which were not within the "limit of tolerated variation" in every respect were analyzed or tested in duplicate. Although a few germination tests could not be made for several months after the samples were collected the results reported are believed to be fairly representative of the respective samples. It is generally recognized that if

our common field seeds are properly stored they lose their germinating power very slowly. Crimson clover and a few others are exceptions to this rule. It should be borne in mind that the dealer is given the benefit of our very liberal germination tolerance. This tolerance varies regularly from 5 per cent. for a "given" germination of 100, to 20 per cent. for a "given" germination of 50. The advantage of the better of the two tests, not the average of the two, was also given the dealer. It is believed that any further advantage that might be given the dealer would constitute a misrepresentation of the sample on our part. Such a misrepresentation would surely be an injustice to every dealer whose samples were found to be better, and to the seed buying public.

Purity Analyses and Germination Tests of Samples of "Straight" Seeds (Section 100 of the Law).

The results of our purity analyses and germination tests of all samples of "straight" seeds were reported in full to the retail dealer, or consignee, from whom the samples were taken and to the person, or firm, deemed responsible for the tagging. There were 1,392 of these samples and it is impracticable to publish the full reports of them which were made to the dealers directly concerned. If all these reports were condensed to the extent that would be necessary to include them in this bulletin they could not be readily understood. Summaries of these results, therefore, must be given. Table I presents them in so far as the wholesale dealers are deemed responsible. Table II shows the results for all the samples collected from each retail dealer.

One of the principal objects of seed inspection work is to point out to the retail seed dealer and the farmer the source of the best seeds obtainable. This is the purpose of Tables I and II. The retail seed dealer should give special attention to Table I. Both tables are worthy of a careful study on the part of the farmer or any one using seeds.

Samples of "Straight" Seeds for Whose Tagging the Wholesale Dealer is Held Responsible.

Table I sets forth what are the most significant facts to be found in this bulletin. Every retail seed dealer and every farmer should give it careful consideration. Approximately ninety per cent. of the agricultural seeds inspected during the year were tagged by the eight wholesale dealers with the largest number of samples in Table I. It would be well to consider Table V in connection with Table I. A number of wholesale dealers are common to both. Some of the smaller wholesale dealers are large retail dealers and are to be found recorded in Table II.

It should be borne in mind that the larger the number of samples, the more significant the results. Results from five samples may be of little significance; results from twenty-five are of considerable significance; and results from one hundred, or more, are of great significance. In fairness to the wholesale dealer he has been held responsible for the accuracy of his properly filled out analysis tags only when they were attached to original, unopened containers.

Table I.

SUMMARY OF TAGGING, PURITY ANALYSES AND GERMINATION TESTS OF SAMPLES OF "STRAIGHT" SEEDS FOR WHOSE TAGGING THE WHOLESALE DEALER IS HELD RESPONSIBLE.

Name of Wholesale Dealer.	Address.	Number of Samples.	Per cent. tagged in accordance with the law in all respects.	Per cent. tagged in accordance with the law, and found to be within the limits of tolerated variation, for:			
				Pure Seed.	Weed Seeds.	Germination.	Pure Seeds, Weed Seeds and Germination.
American Mutual Seed Co	Chicago, Ill.	2	0.0	0.0	0.0	0.0	0.0
Atlantic Seed Co	Philadelphia, Pa.	9	100.0	66.7	88.9	77.8	55.6
The Belt Seed Co	Baltimore, Md.	2	100.0	100.0	100.0	50.0	50.0
A. A. Berry Seed Co	Clarinda, Iowa.	10	0.0	50.0	0.0	80.0	0.0
Blamberg Bros., Inc.*	Baltimore, Md.	105	94.3	72.4	79.0	83.8	60.0
F. W. Bolgiano & Co	Washington, D. C.	2	0.0	100.0	0.0	100.0	0.0
J. Bolgiano & Son*	Baltimore, Md.	145	87.6	82.1	84.1	54.5	42.8
Herbert Bryant's Son	Alexandria, Va.	8	100.0	87.5	100.0	87.5	75.0
J. J. Buffington & Co*	Baltimore, Md.	166	81.3	79.5	72.3	72.3	38.6
Cappelle Hardware Co	Wilmington, Del.	1	100.0	100.0	100.0	100.0	100.0
E. W. Conklin & Son	Binghamton, N. Y.	1	100.0	100.0	100.0	100.0	100.0
Cumberland Seed Co.*	Cumberland, Md.	27	100.0	85.2	92.6	66.7	55.6
Ed. F. Dibble	Honeoye Falls, N. Y.	1	0.0	0.0	0.0	100.0	0.0
The Albert Dickinson Co.*	Chicago, Ill.	32	96.9	96.9	96.9	71.9	65.6

H. W. Doughten, Inc.*	New York, N. Y.	72	88.9	84.7	81.9	52.8	38.9
Emmert Hardware Co	Hagerstown, Md.	4	75.0	75.0	75.0	25.0	0.0
Fred. Co. Farmers Exchange	Frederick, Md.	1	100.0	100.0	0.0	100.0	0.0
Glick's Seed Farms	Smoketown, Pa.	1	100.0	100.0	100.0	100.0	100.0
Griffith & Turner Co	Baltimore, Md.	1	100.0	0.0	0.0	100.0	0.0
A. H. Hoffman, Inc	Landisville, Pa.	4	0.0	0.0	0.0	0.0	0.0
Layton & Layton	Georgetown, Del.	2	0.0	0.0	0.0	0.0	0.0
Nungesser-Dickinson Seed Co	New York, N. Y.	1	0.0	100.0	0.0	0.0	0.0
Pen. Prod. Exchange of Md	Pocomoke City, Md.	4	100.0	75.0	75.0	50.0	50.0
The Philadelphia Seed Co	Philadelphia, Pa.	3	33.3	66.7	66.7	66.7	0.0
I. L. Radwaner Seed Co	New York, N. Y.	1	0.0	0.0	0.0	100.0	0.0
J. A. Salzer Seed Co	La Crosse, Wis.	2	0.0	100.0	0.0	100.0	0.0
Wm. G. Scarlet & Co.*	Baltimore, Md.	54	98.1	88.9	83.3	72.2	57.4
Schindel, Rohrer & Co	Hagerstown, Md.	2	50.0	50.0	0.0	50.0	0.0
Shipley Hardware Co	Meyersdale, Pa.	2	0.0	100.0	0.0	100.0	0.0
The W. A. Simpson Co.*	Baltimore, Md.	96	96.9	84.4	88.5	80.2	63.5
Stanford Seed Co	Buffalo, N. Y.	4	50.0	75.0	50.0	75.0	50.0
Thomas & Co	Frederick, Md.	5	20.0	60.0	60.0	60.0	0.0
C. S. Timmons	Snow Hill, Md.	1	100.0	100.0	100.0	0.0	0.0
T. W. Wood & Sons	Richmond, Va.	4	100.0	75.0	100.0	50.0	50.0
Retail Dealers	Throughout Md.	617	99.0	74.9	84.0	68.7	51.1
All Samples of "Straight" Seed Analyzed		1392	92.0	77.8	81.0	68.7	48.9

*Ninety per cent. of the seeds inspected during 1919 were tagged by the eight firms indicated by asterisks.

Samples of "Straight" Seeds in the Hands of Retail Dealers.

The number of lots of seed found in the hands of the retail seed dealers is small in comparison with the number of samples for whose tagging some of the larger wholesale dealers are held responsible. Forty-four retail dealers, however, had ten or more lots of seed in their hands when inspected. The results for those with a smaller number are not without import. Table II will enable the farmer to compare the samples of the seeds of his own retail dealer with those of other dealers from whom he may buy.

Table II.

SUMMARY OF TAGGING, PURITY ANALYSES AND GERMINATION TESTS OF SAMPLES OF "STRAIGHT" SEEDS IN THE HANDS OF RETAIL DEALERS.

Place of Collection.	Name of Retail Dealer.	Number of Samples.	Per cent. tagged in accordance with the law in all respects.	Per cent. tagged in accordance with the law, and found to be within the limits of tolerated variation, for:			
				Pure Seed.	Weed Seeds.	Germination.	Pure Seeds, Weed Seeds and Germination.
ABERDEEN.	Johnson Bros.	5	100.0	80.0	100.0	60.0	40.0
ACCIDENT.	F. C. Diehl	2	100.0	100.0	100.0	50.0	50.0
	J. L. Englehart	1	100.0	100.0	100.0	100.0	100.0
AIKIN.	P. D. Clark	2	50.0	50.0	100.0	100.0	50.0
ANNAPOLIS.	The Henry B. Myers Co	11	100.0	81.8	100.0	63.6	54.5
ANTIETAM.	James Snyder	2	100.0	100.0	100.0	50.0	50.0
BALTIMORE.	Griffith & Turner Co., Gay St	8	100.0	87.5	100.0	62.5	50.0
	Griffith & Turner Co., Paca St	31	100.0	74.2	90.0	90.0	61.3
	J. Manns & Co	15	100.0	60.0	80.0	66.7	33.3
	Meyer-Stisser Co	8	100.0	75.0	37.5	87.5	75.0
	Wiseman-Downs Co	6	100.0	50.0	100.0	66.7	33.3
BARCLAY.	Butler & Phillips	1	100.0	100.0	100.0	0.0	0.0
BARNESVILLE.	Thomas & Co	2	100.0	100.0	50.0	50.0	50.0
BARTON.	Mowbray Bros.	1	100.0	100.0	100.0	100.0	100.0
BEL AIR.	Boarman & Bradford	12	100.0	66.7	87.5	58.3	50.0
	McComas Bros	10	100.0	90.0	80.0	70.0	60.0

BERLIN.	J. D. Ayers & Bro	2	100.0	100.0	100.0	100.0	100.0
	Berlin Hardware Co	5	100.0	60.0	80.0	100.0	60.0
	J. M. Bratten	4	100.0	75.0	100.0	50.0	25.0
	R. C. Peters & Sons	5	100.0	100.0	100.0	80.0	80.0
	The Purnell Co	2	100.0	0.0	50.0	100.0	0.0
	Taylor & Johnson	2	100.0	50.0	50.0	50.0	50.0
BETTERTON.	Turner & Son	1	100.0	0.0	100.0	0.0	0.0
BOONSBORO.	M. T. Warrenfeltz & Sons	2	100.0	50.0	50.0	100.0	50.0
BRUNSWICK.	S. W. George & Co	6	100.0	100.0	100.0	66.7	66.7
	Swank & Son	5	100.0	60.0	80.0	80.0	60.0
CAMBRIDGE.	The Herbert Hearn Hardware Co	23	100.0	82.6	91.3	69.5	56.5
	Jones & Groff	17	100.0	76.4	52.9	70.0	41.2
	Olin LeCompte	25	100.0	84.0	84.0	80.0	60.0
	The United Stores Co	12	100.0	75.0	75.0	83.3	58.3
CENTREVILLE.	Forman & Mason	7	100.0	85.6	70.0	85.6	57.1
	G. D. Neavitt	5	100.0	80.0	100.0	20.0	20.0
	Wright & Lowe	14	100.0	100.0	85.7	92.8	85.7
CHESAPEAKE CITY.	F. P. Conrey	2	100.0	100.0	100.0	100.0	100.0
CHESTERTOWN.	Davis & Satterfield	14	100.0	78.6	92.9	85.7	64.3
	Claude F. Parks	13	100.0	69.2	92.3	92.3	61.5
CHURCH HILL.	Harry E. Walls	8	100.0	87.5	87.5	75.0	75.0
COCKEYSVILLE.	H. E. Bartleson	9	100.0	88.9	100.0	55.6	55.6
	George Jessop	3	100.0	100.0	100.0	66.7	66.7
COLORA.	Carroll H. Cameron	7	100.0	85.7	100.0	57.1	42.9
CONOWINGO.	C. A. Andrew	7	100.0	85.7	85.7	85.7	85.7
CUMBERLAND.	J. H. Brinker & Bro	6	100.0	66.7	83.3	50.0	33.3
	W. T. Coulehan & Bro	9	100.0	66.7	88.9	33.3	33.3
	S. S. Fisher	3	100.0	100.0	100.0	0.0	0.0
	Flintstone Hdwe. Co., Baltimore St	9	88.9	55.6	66.7	77.8	33.3
	Flintstone Hdwe. Co., Liberty St	2	100.0	100.0	100.0	50.0	50.0
	Jones & Lashley Hardware Co	2	100.0	100.0	100.0	50.0	50.0
	The Kenneweg Co	1	100.0	100.0	100.0	100.0	100.0
DAMASCUS.	W. R. Fairchild	2	100.0	100.0	100.0	100.0	100.0
DENTON.	Nuttle Hardware Co	32	100.0	78.1	84.3	65.6	50.0
	Smith & Walls	10	100.0	100.0	100.0	80.0	80.0
DICKERSON.	Mercer Jones & Son	2	100.0	100.0	100.0	0.0	0.0

TABLE II—*Continued.*

SUMMARY OF TAGGING, PURITY ANALYSES AND GERMINATION TESTS OF SAMPLES OF "STRAIGHT" SEEDS IN THE HANDS OF RETAIL DEALERS.

PLACE OF COLLECTION.	NAME OF RETAIL DEALER.	Number of Samples.	Per cent. tagged in accordance with the law in all respects.	Per cent. tagged in accordance with the law, and found to be within the limits of tolerated variation, for:			
				Pure Seed.	Weed Seeds.	Germination.	Pure Seeds, Weed Seeds and Germination.
DUBLIN.	Nelson McCann	4	100.0	100.0	100.0	50.0	50.0
EAST NEW MARKET.	Saxton & Parker	4	100.0	75.0	75.0	50.0	50.0
	P. L. Willis	4	100.0	100.0	100.0	75.0	75.0
EASTON.	Nevius & Frampton	9	100.0	77.8	88.9	77.8	44.4
	Shannahan & Wrightson Hdwe. Co	13	100.0	84.6	69.2	76.9	38.5
	N. Tuthill & Son	20	100.0	65.0	75.0	75.0	50.0
ELKTON.	Evans Bros	3	100.0	66.7	100.0	66.7	66.7
	R. B. Frazier	1	100.0	100.0	100.0	0.0	0.0
	J. E. Gonce	10	100.0	80.0	90.0	60.0	50.0
	Keys & Miller Lumber Co	5	100.0	60.0	80.0	40.0	40.0
ELLICOTT CITY.	J. L. Clark	23	91.3	69.5	78.2	56.5	34.8
	W. R. Dorsey	11	100.0	72.7	81.8	63.6	54.5
	E. A. Talbott	14	100.0	71.4	78.5	57.1	42.9
EMMITSBURG.	Boyle Bros	5	100.0	80.0	100.0	60.0	40.0
	E. L. Frizell	4	100.0	100.0	75.0	100.0	75.0

FAIRLEE.						
FEDERALSBURG.	T. H. M. Bramble	3	100.0	100.0	100.0	100.0	100.0
	Covey & Williams	1	100.0	100.0	100.0	0.0	0.0
	W. T. Eddington	2	100.0	50.0	100.0	100.0	50.0
	J. W. Hurlock & Co.	13	100.0	84.6	84.6	38.5	30.8
FOREST HILL.	J. A. Hyland	8	100.0	75.0	75.0	62.5	25.0
	H. F. Stowell & Son	3	100.0	100.0	33.3	100.0	33.3
FREDERICK.	E. Tucker & Co.	12	100.0	75.0	75.0	50.0	25.0
	C. H. Wilson	6	100.0	83.3	66.7	50.0	33.3
	Fred. Co. Farmers' Exchange	6	100.0	100.0	100.0	66.7	66.7
FREELAND.	P. L. Hargett & Co.	13	100.0	76.9	76.9	69.2	38.5
	Thomas & Co.	7	100.0	71.4	71.4	14.3	14.3
	A. G. Quynn & Co.	8	100.0	62.5	87.5	50.0	50.0
FROSTBURG.	J. E. Shaver & Co.	2	100.0	100.0	100.0	0.0	0.0
FRUITLAND.	L. M. B. Williams	2	100.0	50.0	100.0	100.0	50.0
GAITHERSBURG.	E. B. Prichard & Co.	5	100.0	60.0	60.0	100.0	40.0
	N. W. Carey	1	100.0	100.0	100.0	100.0	100.0
GALENA.	H. H. Griffith & Co.	4	100.0	75.0	100.0	75.0	50.0
	Thomas & Co.	8	100.0	75.0	87.5	75.0	62.5
	Davis Bros.	4	100.0	75.0	100.0	100.0	75.0
GEORGETOWN.	The Davis Co.	2	100.0	100.0	100.0	50.0	50.0
GERMANTOWN.	W. A. Hyland	1	100.0	100.0	100.0	100.0	100.0
GOLDSBORO.	J. E. Woodall, Jr.	6	100.0	83.3	83.3	83.3	66.7
	C. T. Johnson	6	100.0	100.0	66.7	50.0	33.3
	W. T. Jarman & Bro.	1	100.0	0.0	0.0	100.0	0.0
GORTNER.	J. F. Lane	2	100.0	50.0	0.0	50.0	0.0
GRACEHAM.	W. J. Murphy	11	100.0	63.6	90.9	72.7	45.4
GRANTSVILLE.	W. E. Spoerlin	6	100.0	50.0	50.0	83.3	33.3
	L. B. Nicodemus	4	100.0	75.0	100.0	75.0	50.0
	J. J. Bender	2	100.0	100.0	100.0	50.0	50.0
GREENMOUNT.	Gilead Broadwater	3	100.0	33.3	33.3	100.0	33.3
GREENSBORO.	W. E. Stanton	1	100.0	100.0	100.0	100.0	100.0
	J. A. DeHoff	1	100.0	100.0	100.0	100.0	100.0
	C. B. Jarman	8	100.0	75.0	100.0	37.5	12.5
	Mrs. Gertrude Longfellow	2	100.0	100.0	100.0	100.0	100.0
	W. L. Longfellow	2	100.0	50.0	100.0	100.0	50.0

TABLE II—*Continued.*

SUMMARY OF TAGGING, PURITY ANALYSES AND GERMINATION TESTS OF SAMPLES OF "STRAIGHT" SEEDS IN THE HANDS OF RETAIL DEALERS.

PLACE OF COLLECTION.	NAME OF RETAIL DEALER.	Number of Samples.	Per cent. tagged in accordance with the law in all respects.	Per cent. tagged in accordance with the law, and found to be within the limits of tolerated variation, for:			
				Pure Seed.	Weed Seeds.	Germination.	Pure Seeds, Weed Seeds and Germination.
HAGERSTOWN.	Emmert Hardware Co.	13	76.9	76.9	61.5	61.5	30.8
	C. M. Horst	16	100.0	56.2	93.7	75.0	50.0
	E. W. Miller	19	100.0	78.9	94.7	63.1	63.1
	H. S. Myers	5	100.0	100.0	100.0	80.0	80.0
	Schindel, Rohrer & Co.	1	100.0	100.0	100.0	100.0	100.0
HAMPSTEAD.	P. A. Rinaman	7	100.0	100.0	100.0	100.0	100.0
	Switzler & Bixler	6	100.0	83.3	83.3	83.3	50.0
HANCOCK.	Anthony & Callan	1	100.0	100.0	100.0	0.0	0.0
	S. R. Cohill	1	100.0	100.0	100.0	0.0	0.0
	Faith & Exline	3	100.0	100.0	100.0	100.0	100.0
HARMONY GROVE.	D. C. Ramsburg & Son	1	100.0	100.0	100.0	100.0	100.0
HILLSBORO.	Charles Jarrell	8	100.0	75.0	50.0	50.0	37.5
	Stewart & Jarrell	8	100.0	75.0	100.0	87.5	75.0
HURLOCK.	W. C. Bradley & Son	19	100.0	73.7	84.2	57.9	47.4
	Wright Hardware Co.	4	100.0	100.0	100.0	100.0	100.0

INGLESIDE.	Wilson & Merrick	4	100.0	75.0	75.0	75.0	50.0
JEFFERSON.	C. E. & H. C. Summers	1	100.0	100.0	100.0	0.0	0.0
KEEDYSVILLE.	H. K. Zimmerman	5	100.0	80.0	80.0	60.0	60.0
KENNEDYVILLE.	Shafer, Redmile & Co.	6	100.0	100.0	83.3	83.3	66.7
KEYMAR.	W. F. Cover & Son	3	100.0	100.0	100.0	100.0	100.0
LAUREL.	Athey & Harrison	19	100.0	84.2	89.4	68.4	63.1
	G. W. Waters Co.	12	100.0	66.7	83.3	75.0	50.0
LESLIE.	C. A. Benjamin & Co.	4	100.0	100.0	100.0	75.0	75.0
LINWOOD.	J. A. Englar	4	100.0	75.0	100.0	100.0	75.0
LONACONING.	L. Durst & Son	3	100.0	33.3	66.7	100.0	33.3
	J. M. Sloan & Son	1	100.0	100.0	100.0	100.0	100.0
MARYDEL.	J. T. Heather	8	100.0	62.5	100.0	87.5	62.5
MASSEY.	A. F. Huey	11	100.0	90.9	100.0	63.6	63.6
MEDFORD.	Medford Grocery Co.	2	100.0	100.0	100.0	50.0	50.0
MIDDLEBURG.	Thomas & Co.	4	100.0	75.0	75.0	100.0	75.0
MIDDLETOWN.	D. V. Beachley & Bro.	2	100.0	100.0	100.0	50.0	50.0
	People's Supply Co.	1	100.0	100.0	100.0	0.0	0.0
MILLINGTON.	Paul Comyges	9	88.9	77.8	77.8	88.9	55.6
	R. E. Feddeman	2	100.0	100.0	100.0	100.0	100.0
MONKTON.	L. B. Bishop	1	100.0	100.0	100.0	100.0	100.0
MONROVIA.	V. W. Nicodemus	1	100.0	100.0	100.0	100.0	100.0
MT. LAKE PARK.	Harvey Bros.	1	100.0	100.0	100.0	100.0	100.0
MOUNT AIRY.	W. O. Banks & Co.	1	100.0	0.0	100.0	0.0	0.0
	B. S. Dorsey Co.	8	100.0	100.0	75.0	75.0	62.5
	C. A. Fleming	2	100.0	0.0	100.0	0.0	0.0
	W. H. & C. R. Hood	4	100.0	100.0	100.0	75.0	75.0
	Piedmont-Mt. Airy Guano Co.	3	0.0	66.7	66.7	0.0	0.0
MYERSVILLE.	Farmers' Mutual Exchange	2	100.0	100.0	100.0	50.0	50.0
	Myersville Supply Co.	1	100.0	100.0	100.0	0.0	0.0
NEW MIDWAY.	Browning & Haugh	1	100.0	0.0	0.0	0.0	0.0
	S. J. Grim	2	100.0	50.0	50.0	100.0	0.0
	A. A. Haugh	1	100.0	100.0	100.0	100.0	100.0
NEW WINDSOR.	Devilbliss Bros.	1	100.0	100.0	100.0	100.0	100.0
	D. P. Smelser & Son	7	100.0	71.4	71.4	85.7	28.6
OAKLAND.	D. M. Dixon & Co.	2	100.0	50.0	50.0	100.0	50.0
	D. E. Offutt & Son	5	100.0	100.0	100.0	80.0	80.0
	J. P. Treacy	1	100.0	100.0	100.0	100.0	100.0

TABLE II—*Continued.*

SUMMARY OF TAGGING, PURITY ANALYSES AND GERMINATION TESTS OF SAMPLES OF "STRAIGHT" SEEDS IN THE HANDS OF RETAIL DEALERS.

Place of Collection.	Name of Retail Dealer.	Number of Samples.	Per cent. tagged in accordance with the law in all respects.	Per cent. tagged in accordance with the law, and found to be within the limits of tolerated variation, for:			
				Pure Seed.	Weed Seeds.	Germination.	Pure Seeds, Weed Seeds and Germination.
PARKTON.	W. N. Krout	2	100.0	100.0	100.0	50.0	50.0
PERRYMAN.	W. C. Holloway	1	100.0	100.0	100.0	100.0	100.0
POCOMOKE CITY.	Johnson Bros.	6	100.0	66.7	50.0	50.0	33.3
	N. Davis & Son	13	100.0	92.3	84.6	69.2	63.8
	Lloyd & Blaine	3	100.0	33.3	66.7	100.0	33.3
PORT DEPOSIT.	Peninsula Produce Exc. of Md	33	100.0	72.7	90.9	72.7	54.5
PRESTON.	Campbell Bros.	2	100.0	100.0	100.0	0.0	0.0
	J. L. Covey & Bro.	10	100.0	70.0	100.0	80.0	50.0
	J. A. Cox	3	100.0	100.0	100.0	0.0	0.0
PRICES.	L. C. Reid	1	100.0	100.0	100.0	100.0	100.0
PRINCESS ANNE.	W. J. Massey	10	100.0	80.0	90.0	60.0	50.0
	C. H. Hayman	9	100.0	55.6	55.6	66.7	33.3
	E. G. Newton	3	100.0	33.3	100.0	66.7	0.0
PROVIDENCE.	W. P. Todd	16	100.0	93.7	81.2	50.0	43.7
QUEEN ANNE.	G. W. Biles Co.	7	100.0	85.7	85.7	57.1	57.1
	Jump Hardware & Implement Co	10	100.0	90.0	70.0	60.0	50.0

REISTERSTOWN.	L. C. Caltrider	8	100.0	62.5	75.0	50.0	25.0
RIDGELY.	T. W. Jones	2	100.0	100.0	100.0	100.0	100.0
	J. W. Simon	9	100.0	100.0	100.0	66.7	66.7
RISING SUN.	Biles & Cameron	8	100.0	100.0	100.0	75.0	75.0
	Sterritt & Ward	15	100.0	80.0	86.7	53.3	33.3
ROCKVILLE.	Holland & Clark	7	100.0	85.7	85.7	42.9	42.9
	W. W. Welch Estate	4	100.0	100.0	50.0	75.0	25.0
SALISBURY.	Dorman & Smith Hardware Co	14	100.0	57.1	78.6	78.6	35.7
	Farmers' & Planters' Co	1	100.0	100.0	100.0	100.0	100.0
	L. W. Gunby Co	1	0.0	0.0	0.0	0.0	0.0
	Mitchell & Goslee Hardware Co	4	100.0	75.0	100.0	50.0	25.0
SANDY BOTTOM.	A. Cohen	14	100.0	50.0	85.7	92.9	42.9
SECRETARY.	D. M. Webster	5	100.0	60.0	60.0	80.0	40.0
SHARPTOWN.	J. P. Cooper & Co	1	100.0	100.0	100.0	0.0	0.0
SMITHSBURG.	Geiser & Wolfinger	2	100.0	100.0	100.0	0.0	0.0
	J. T. Towson & Son	8	100.0	100.0	100.0	62.5	62.5
SNOW HILL.	W. T. Cherrix	3	100.0	66.7	66.7	66.7	33.3
	C. S. Timmons	8	100.0	87.5	87.5	87.5	62.5
SPARKS.	S. G. Sparks & Co	2	100.0	100.0	100.0	0.0	0.0
STILL POND.	Wm. Medders & Co	15	100.0	100.0	86.7	60.0	46.7
STREET.	Gailey Bros. & Orr	4	100.0	75.0	100.0	50.0	25.0
SUDLERSVILLE.	J. T. Nickerson	7	85.7	71.4	85.7	100.0	57.1
	W. D. Roe & Son	1	100.0	100.0	100.0	100.0	100.0
SYKESVILLE.	Md. Milling & Supply Co	14	100.0	92.9	85.7	42.9	42.9
TANEYTOWN.	The Reindollar Co	6	100.0	83.3	66.7	66.7	33.3
	Taneytown Grain & Supply Co	10	100.0	80.0	90.0	90.0	70.0
THURMONT.	G. W. Stocksdale	6	83.3	100.0	83.3	83.3	66.7
	D. S. Weybright	3	100.0	66.2	100.0	66.7	33.3
TOWSON.	W. A. Lee	5	80.0	80.0	80.0	80.0	80.0
TRAPPE.	Nevius Bros	8	100.0	87.5	100.0	62.5	62.5
	D. T. Simpson & Son	3	100.0	100.0	33.3	100.0	33.3
UNION BRIDGE.	C. E. Engel & Co	6	100.0	100.0	83.3	100.0	83.3
	Farmers' Exchange Co	3	100.0	100.0	100.0	66.7	66.7
	Thomas & Co	2	100.0	50.0	100.0	50.0	50.0
VIENNA.	G. W. Millard	2	100.0	100.0	100.0	50.0	50.0
WALKERSVILLE.	J. H. Jamison	5	100.0	100.0	100.0	60.0	60.0
	J. H. Stauffer	3	100.0	100.0	100.0	66.7	66.7
	G. C. Winebrener	1	100.0	100.0	100.0	0.0	0.0

TABLE II—*Continued.*

SUMMARY OF TAGGING, PURITY ANALYSES AND GERMINATION TESTS OF SAMPLES OF "STRAIGHT" SEEDS IN THE HANDS OF RETAIL DEALERS.

PLACE OF COLLECTION.	NAME OF RETAIL DEALER.	Number of Samples.	Per cent. tagged in accordance with the law in all respects.	Per cent. tagged in accordance with the law, and found to be within the limits of tolerated variation, for:			
				Pure Seed.	Weed Seeds.	Germination.	Pure Seeds, Weed Seeds and Germination.
WESTERNPORT.	Westernport Mercantile Co.	1	100.0	100.0	100.0	100.0	100.0
WESTMINSTER.	Farmers' Fertilizer & Feed Co.	7	100.0	100.0	85.7	85.7	71.4
	Farmers' Supply Co.	14	64.3	35.7	57.1	35.7	35.7
WHALEYSVILLE.	Wimbrow Bros.	1	100.0	100.0	100.0	100.0	100.0
WHITE HALL.	T. C. Hunter	6	100.0	66.7	83.3	33.3	16.7
WOODBINE.	J. M. DeLashmutt & Son	8	87.5	62.5	75.0	75.0	50.0
WOODSBORO.	Miller & Cramer	2	100.0	50.0	100.0	100.0	50.0
THROUGHOUT MARYLAND.	Thirty-seven (37) consignees	56	53.6	67.9	53.6	44.6	28.6
	The 1392 samples of "Straight" Seeds analyzed	..	92.0	77.8	81.0	68.7	48.9

Purity Analyses and Germination Tests of Samples of Specified Mixtures (Section 101 of the Law).

The results of the purity analyses and germination tests of the four samples of mixtures specified in Section 101 of the Seed Law which were collected during the year are reported in Table III. Not one of these samples was tagged in accordance with the requirements of the law. One of them, number 194591, was foul with weed seeds and carried less than two-thirds of the pure seeds it was represented to contain. Judging from the samples of this class on which reports are made in this bulletin, no good reason is apparent for farmers buying mixtures of seeds which they can make up themselves with very little trouble.

Table III.

RECORD OF TAGGING, PURITY ANALYSES AND GERMINATION TESTS OF SAMPLES OF SPECIFIED MIXTURES. L T V=LIMIT OF TOLERATED VARIATION.

Laboratory Number.	Place of Collection Vendor (or Consignee—c) Tagger.	Kind of Mixture.		Per Cent. of Pure Seed.	Per Cent. of Weed Seeds.	Per Cent. of Germination.	Tested for Germination.
194591	EMMITSBURG J. L. Gloninger—c **J. Bolgiano & Son**	Timothy	Given	**98.50**[1]	0.90	**89.00**[2]	Jan. 19
			L T V		1.18	....	
			Found	49.81	**12.98**	84.50	May 19
		Alsike clover	Given				
			L T V				
			Found	9.72	....	76.50	May 19
194763	FROSTBURG Frank Hayes—c **Ed. F. Dibble**	Timothy	Given	72.57	**1.51**[3]	**n-g**	
			L T V	66.88			
			Found	74.59	0.15	98.00	May 19
		Alsike clover	Given	25.92		**n-g**	
			L T V	20.54			
			Found	24.19		92.00	Feb. 20
194199	GAITHERSBURG Scholastica Haufmann—c **Condon Bros.**	Timothy	Given	**n-g**	**n-g**	**n-g**	
			L T V				
			Found	84.57	0.35	88.50	May 19
		Alsike clover	Given	**n-g**		**n-g**	
			L T V				
			Found	13.68		87.50	May 19
194726	GRANTSVILLE **Gilead Broadwater** **A. A. Berry Seed Co.**	Timothy	Given	63.00	**(2.00)**	88.00[2]	Jan. **(19)**
			L T V	55.40	2.50	....	
			Found	76.53	**4.51**	90.50	May 19
		Alsike clover	Given	30.00			
			L T V	23.80			
			Found	**4.85**	....	49.00	May 19

[1]Percentage of purity of both timothy and alsike clover erroneously combined.
[2]Percentage of germination of both timothy and alsike clover erroneously combined.
[3]

Purity Analyses of Samples of Special Mixtures (Section 102 of the Law).

Reports are made on samples of fifty so-called lawn and pasture mixtures and nine miscellaneous mixtures, all coming under Section 102 of the Seed Law, in Table IV. A glance at this table will show that a large proportion of them are not properly tagged; also, that an even larger proportion are not what they are represented to be. In the preparation of Table IV the tolerance tables applying elsewhere in this bulletin have also been applied to the kinds of seeds. If a "given" kind did not fall below the "limit of tolerated variation" it was considered present in the proportion of five per cent. Similarly, if a kind not "given" did not exceed the "limit of tolerated variation" it was considered not present in the proportion of five per cent.

The "given" analyses of certain samples of special mixtures, notably those from some of the Five and Ten Cent Stores of Baltimore, should be enough to cause any one to hesitate to buy them for sowing on a lawn.

Table IV.

RECORD OF TAGGING AND PURITY ANALYSES OF SAMPLES OF SPECIAL MIXTURES.
L T V=LIMIT OF TOLERATED VARIATION.

Laboratory Number.	Place of Collection Vendor (or Consignee—c) Tagger.	Kinds Present in the Proportion of Five Per Cent. or More.		Per Cent. of		
		Given.	Found.		Weed Seeds.	Inert Matter.
194797	ANNAPOLIS **The Henry B. Myers Co.** **Untagged.**	**Not given**	Red top Timothy Bluegrass White clover	Given L T V Found	**n-g** 4.77	**n-g** 25.62
194819	BALTIMORE J. Bolgiano & Son **J. Bolgiano & Son**	Bluegrass Red top	Bluegrass Red top **Sweet clover**	Given L T V Found	0.46 0.65 **0.74**	13.82 16.68 16.42
194820	BALTIMORE J. Bolgiano & Son **J. Bolgiano & Son**	Can. bluegrass Ky. bluegrass Red top White colver[1]	Can. bluegrass Ky. bluegrass Red top White clover	Given L T V Found	0.48 0.68 **0.75**	13.80 16.66 16.35
194847	BALTIMORE Griffith & Turner Co. **Griffith & Turner Co.**	Red top Bluegrass **White Clover**	Red top Bluegrass	Given L T V Found	2.60 3.22 1.75	28.00 33.70 25.36
194851	BALTIMORE S. S. Kresge Co. **S. S. Kresge Co.**	Timothy Ky. bluegrass Red top **Ryegrass**	Timothy Ky. bluegrass Red top	Given L T V Found	4.00 4.90 **6.06**	26.00 31.30 **44.38**

[1]Percentage of white clover given as 4.02.

194850	BALTIMORE	Timothy	Timothy	Given	1.96	23.96
	J. G. McCrory Co.	Ryegrass	Ryegrass	L T V	4.90	31.30
	Whitney-Eckstein Seed Co.	Ky. bluegrass	Ky. bluegrass	Found	3.88	**39.39**
		Red top	Red top			
194810	BALTIMORE	Eng. ryegrass	Eng. ryegrass	Given	0.56	10.66
	The Myer-Stisser Co.	Red top	Red top	L T V	0.77	12.89
	The Myer-Stisser Co.	Ky. bluegrass	Ky. bluegrass	Found	0.55	10.49
		White clover	White clover			
		Crt. dogstail				
194848	BALTMIORE	Red top	Red top	Given	1.85	42.45
	J. W. Tottle	Timothy	Timothy	L T V	2.32	51.04
	J. W. Tottle	Eng. ryegrass	Eng. ryegrass	Found	1.92	45.80
194813	BALTIMORE	Red top	Red top	Given	0.81	21.55
	Wiseman-Downs Co.	Ky. bluegrass	Ky. bluegrass	L T V	1.07	25.96
	Wiseman-Downs Co.	Timothy	Timothy	Found	0.94	20.19
		White clover	White clover			
194849	BALTIMORE	Red top	Red top	Given	4.00	26.00
	F. W. Woolworth Co.	Ryegrass	Ryegrass	L T V	4.90	31.30
	Whitney-Eckstein Seed Co.	Ky. bluegrass	Ky. bluegrass	Found	4.62	**41.35**
		Timothy	Timothy			
194976	BERLIN	**Not given**	Bluegrass	Given	**n-g**	**n-g**
	R. C. Peters & Sons		Red top	L T V		
	Untagged			Found	1.45	23.20
195471	CAMBRIDGE	Bluegrass	Bluegrass	Given	0.46	13.82
	Herbert Hearn Hdwe. Co.	Red top	Red top	L T V	0.65	16.68
	J. Bolgiano & Son	White clover[1]	White clover	Found	**1.38**	11.90
194269	CAMBRIDGE	Timothy	Timothy	Given	0.32[2]	**n-g**
	Orem & Winterbottom—c	Mam. clover	Mam. clover	L T V	0.48	
	Wm. G. Scarlett & Co.	Red top	Red top	Found	**0.51**	3.43
194270	CAMBRIDGE	Timothy	Timothy	Given	0.04[2]	**n-g**
	Orem & Winterbottom—c	Mam. clover	Mam. clover	L T V	0.15	
	Wm. G. Scarlett & Co.	Alfalfa	Alfalfa	Found	0.05	0.30

[1]Percentage of white clover given as 4.27.
[2]Percentage mean.

TABLE IV—*Continued.*

RECORD OF TAGGING AND PURITY ANALYSES OF SAMPLES OF SPECIAL MIXTURES.
L T V=LIMIT OF TOLERATED VARIATION.

Laboratory Number.	Place of Collection Vendor (or Consignee—c) Tagger.	Kinds Present in the Proportion of Five Per Cent. or More.		Per Cent. of		
		Given.	Found.		Weed Seeds.	Inert Matter.
194871	CENTREVILLE Wright & Lowe **The W. A. Simpson Co.**	Red top Ky. bluegrass Can. bluegrass Ryegrass Red fescue Meadow fescue	Red top Ky. bluegrass Can. bluegrass Ryegrass Red fescue Meadow fescue	Given L T V Found	0.50 0.70 **0.80**	6.45 7.84 **16.88**
194861	CHESTERTOWN Davis & Satterfield Blamberg Bros.	Red top Bluegrass White clover Meadow fescue	Red top Bluegrass White clover Meadow fescue	Given L T V Found	2.00 2.50 1.56	16.00 19.20 16.16
194450	CHESTERTOWN Davis & Satterfield Davis & Satterfield	Red top Bluegrass White clover Meadow fescue	Red top Bluegrass White clover Meadow fescue	Given L T V Found	2.00 2.50 1.34	16.00 19.20 17.55
195042	CHESTERTOWN C. L. Jarrell—c **J. Bolgiano & Son**	Cow pea Soy bean	Cow pea Soy bean	Given L T V Found	**n-g** 0.00	**n-g** 1.36
195423	CHURCH HILL H. E. Walls **H. E. Walls**	Red top Ky. bluegrass	Red top Ky. bluegrass **White clover**	Given L T V Found	3.00 3.70 1.51	20.00 24.10 17.45

194660	COCKEYSVILLE	**Not given**	Red top	Given	0.50	6.45
	H. E. Bartleson		Meadow fescue	L T V	0.70	7.84
	The W. A. Simpson Co.		Bluegrass	Found	**0.82**	**16.66**
			Red fescue			
194930	EAST NEW MARKET	Red top	Red top	Given	0.75	10.00
	Saxton & Parker	Bluegrass	Bluegrass	L T V	1.00	12.10
	Saxton & Parker	Meadow fescue	Meadow fescue	Found	0.83	7.47
		Ryegrass	Ryegrass			
		White clover				
194883	EASTON	**Not given**	Bluegrass	Given	0.10	5.73
	Nevius & Frampton		Red top	L T V	0.22	6.98
	J. J. Buffington & Co.		Ryegrass	Found	**0.50**	**10.53**
194881	EASTON	Soy bean	Soy bean	Given	0.25	**n-g**
	Nevius & Frampton	Cow pea	Cow pea	L T V	0.40	
	Wm. G. Scarlett & Co.			Found	0.17	0.25
195454	EASTON	**(Ky. bluegr.)**	Ky. bluegrass	Given	0.18	**(5.00)**
	N. Tuthill & Son	**(White clover)**	**Ryegrass**	L T V	0.32	6.10
	J. J. Buffington & Co.		**Red top**	Found	**0.63**	**25.30**
195456	EASTON	Meadow fescue	Meadow fescue	Given	2.80	6.90
	N. Tuthill & Son	Ryegrass	Ryegrass	L T V	3.46	8.38
	The W. A. Simpson Co.	Tall fescue	Tall fescue	Found	3.13	8.36
		Red top	Red top			
		Ky. bluegrass	Ky. bluegrass			
		Can. bluegrass	Can. bluegrass			
		Crt. dogstail	Crt. dogstail			
		Red fescue	Red fescue			
195260	ELLICOTT CITY	Blue grass	Bluegrass	Given	0.46	13.82
	E. A. Talbott	Red top	Red top	L T V	0.65	16.68
	J. Bolgiano & Son	White clover[1]	White clover	Found	0.61	**18.25**

[1]Percentage of white clover given as 4.27.

TABLE IV—*Continued.*

RECORD OF TAGGING AND PURITY ANALYSES OF SAMPLES OF SPECIAL MIXTURES.
L T V=LIMIT OF TOLERATED VARIATION.

Laboratory Number.	Place of Collection Vendor (or Consignee– c) Tagger.	Kinds Present in the Proportion of Five Per Cent. or More.		Per Cent. of		
		Given.	Found.		Weed Seeds.	Inert Matter.
194995	FEDERALSBURG W. T. Eddington W. T. Eddington	Cow pea Soy bean	Cow pea Soy bean	Given L T V Found	0.25 0.40 0.06	2.00 2.50 0.44
195502	FEDERALSBURG J. A. Hyland **Griffith & Turner**	Red top Bluegrass **White clover**	Red top Bluegrass	Given L T V Found	2.60 3.22 1.46	28.00 33.70 28.55
194998	FEDERALSBURG H. B. Messenger—c **T. W. Wood & Sons**	Cow pea Soy bean	Cow pea Soy bean	Given L T V Found	0.10 0.22 0.00	**n-g** 0.50
194783	FREDERICK **A. G. Quinn & Co.** **Griffith & Turner Co.**	**Not given**	Bluegrass Orchard grass White clover	Given L T V Found	2.25 2.80 1.70	12.50 15.10 **19.68**
195144	FREDERICK **A. G. Quinn & Co.** **Griffith & Turner Co.**	**Not given**	Red top Bluegrass Ryegrass	Given L T V Found	0.50 0.70 0.60	35.50 42.70 32.10
195314	FREELAND L. M. B. Williams L. M. B .Williams	Ky. bluegrass Red top White clover	Ky. bluegrass Red top White clover	Given L T V Found	4.00 4.90 1.62	21.00 25.30 18.46

194198	GAITHERSBURG Scholastica Haufmann—c **Condon Bros.**	**Not given**	Sweet clover Crimson clover Alfalfa	Given L T V Found	**n-g** 0.37	**n-g** 1.57
195052	GEORGETOWN J. E. Woodall, Jr. **The W. A. Simpson Co.**	Crt. dogstail Ryegrass Meadow fescue Tall fescue Timothy Bluegrass Red fescue Red clover	Crt. dogstail Ryegrass Meadow fescue Tall fescue Timothy Bluegrass Red fescue Red clover **Rep top**	Given L T V Found	1.15 1.48 1.35	15.95 19.24 **21.73**
195022	GREENSBORO **C. B. Jarman** **J. J. Buffington & Co.**	**Not given**	Red top Bluegrass Ryegrass	Given L T V Found	0.10 0.22 **0.75**	**n-g** 17.02
195121	HAGERSTOWN E. W. Miller **E. W. Miller**	Ky. bluegrass Red top **Orchard grass** **T. M. Oatgrass**	Ky. bluegrass Red top **Meadow fescue**	Given L T V Found	11.50 13.90 0.60	19.25 23.20 **26.40**
195031	MARYDEL J. T. Heather **J. T. Heather**	Cow pea Soy bean	Cow pea Soy bean	Given L T V Found	0.20 0.34 0.31	1.00 1.30 **2.79**
194492	MILLINGTON **P. Comyges** **J. J. Buffington & Co.**	**Not given**	Blue grass Timothy Red top	Given L T V Found	**n-g** 0.40	**n-g** 8.30
194493	MILLINGTON **P. Comyges** **J. J. Buffington & Co.**	**Not given**	Blue grass Timothy Ryegrass Red top	Given L T V Found	**n-g** 0.34	**n-g** 8.18

TABLE IV—*Continued.*

RECORD OF TAGGING AND PURITY ANALYSES OF SAMPLES OF SPECIAL MIXTURES.
L T V=LIMIT OF TOLERATED VARIATION.

Laboratory Number.	Place of Collection Vendor (or Consignee—c) Tagger.	Kinds Present in the Proportion of Five Per Cent. or More.		Per Cent. of		
		Given.	Found.		Weed Seeds.	Inert Matter.
195229	MOUNT AIRY B. S. Dorsey Co. The W. A. Simpson Co.	Red top Ryegrass Meadow fescue Crt. dogstail Ky. bluegrass Can. bluegrass	Red top Ryegrass Meadow fescue Crt. dogstail Ky. bluegrass Can. bluegrass	Given L T V Found	3.14 3.87 1.62	7.91 9.59 7.20
194651	PARKTON **W. N. Krout** Untagged	**Not given**	Meadow fescue Red top Bluegrass Crt. dogstail	Given L T V Found	**n-g** 0.65	**n-g** 7.00
195578	POCOMOKE CITY Lloyd & Blaine **Lloyd & Blaine**	Ky. bluegrass Red top **Meadow fescue**	Ky. bluegrass Red top	Given L T V Found	2.00 2.50 1.41	15.00 18.10 **28.66**
195596	POCOMOKE CITY Pen. Pro. Exc. of Md. **Pen. Pro. Exc. of Md.**	Timothy Red clover Meadow fescue Per. ryegrass Ital. ryegrass Orchard grass Alsike clover Red top	Timothy Red clover Meadow fescue Per. ryegrass Ital. ryegrass Orchard grass Alsike clover Red top	Given L T V Found	1.35 1.72 **2.00**	4.85 5.92 2.53

194896	PRESTON	**(Red top)**	Red top	Given	0.50	6.45
	J. L. Covey & Bro.	**(Ky. bluegr.)**	Ky. bluegrass	L T V	0.70	7.84
	The W. A. Simpson Co.	**(Mead. fescue)**	Meadow fescue	Found	**0.83**	**14.75**
		(Per. ryegrass)	Per. ryegrass			
		(White clover)	**Red fescue**			
194937	PRINCESS ANNE	Red top	Red top	Found	2.00	16.00
	C. H. Hayman	Bluegrass	Bluegrass	Given	2.50	19.30
	Blamberg Bros.	White clover	White clover	L T V	1.76	15.48
		Meadow fescue	Meadow fescue			
194946	PRINCESS ANNE	Soy bean	Soy bean	Given	0.05	**n-g**
	W. P. Todd	Cow pea	Cow pea	L T V	0.16	
	J. Bolgiano & Son			Found	0.00	1.75
195020	RIDGELY	Can. bluegrass	Can. bluegrass	Given	2.25	21.79
	J. W. Simon	Red top	Red top	L T V	2.92	26.25
	The W. A. Simpson Co.	Crt. dogstail	Crt. dogstail	Found	1.62	24.84
		Per, ryegrass	Per, ryegrass			
		Tall fescue	Tall fescue			
		Meadow fescue	Meadow fescue			
194936	SALISBURY	Meadow fescue	Meadow fescue	Given	1.73	12.72
	Dorman & Smith Hdwe. Co.	Timothy	Timothy	L T V	2.18	15.36
	J. J. Buffington & Co.	Red top	Red top	Found	1.21	3.65
		Ital. ryegrass	Ital. ryegrass			
		Orchard grass				
194935	SALISBURY	**Not given**	Red top	Given	**n-g**	**n-g**
	Dorman & Smith Hdwe. Co.		Timothy	L T V		
	Dorman & Smith Hdwe. Co.		Meadow fescue	Found	1.61	15.66
			Bluegrass			
195569	SALISBURY	Red top	Red top	Given	2.00	15.00
	Dorman & Smith Hdwe. Co.	Ky. bluegrass	Ky. bluegrass	L T V	2.50	18.10
	Dorman & Smith Hdwe. Co.	**White clover**	**Timothy**	Found	1.59	16.56
			Ryegrass			

TABLE IV—*Continued.*

RECORD OF TAGGING AND PURITY ANALYSES OF SAMPLES OF SPECIAL MIXTURES.
L T V=LIMIT OF TOLERATED VARIATION.

Laboratory Number.	Place of Collection Vendor (or Consignee—c) Tagger.	Kinds Present in the Proportion of Five Per Cent. or More.		Per Cent. of		
		Given.	Found.		Weed Seeds.	Inert Matter.
194314	SALISBURY L. W. Gunby Co. **J. Bolgiano & Son**	Ky. bluegrass Ital. ryegrass White clover **Red top** **Timothy**	Ky. bluegrass Ital. ryegrass White clover	Given L T V Found	1.25 1.60 0.36	21.00 25.30 17.40
195561	SALISBURY L. W. Gunby Co. **J. Bolgiano & Son**	Bluegrass Red top White clover	Bluegrass Red top White clover **Ryegrass**	Given L T V Found	1.85 2.32 0.46	14.83 17.90 **20.50**
195576	SNOW HILL **W. T. Cherrix** **Pen. Pro. Exc. of Md.**	**(Red top)** **(Ky. bluegr.)** **(Mead. fescue)**	Red top Ky. bluegrass Meadow fescue	Given L T V Found	0.10 0.22 **1.82**	**(15.00)** 18.10 **26.69**
195240	SYKESVILLE Md. Mill. & Supply Co. The W. A. Simpson Co.	Red top Tall fescue Meadow fescue Timothy Crt. dogstail Bluegrass R. S. Meadow gr. Red clover	Red top Tall fescue Meadow fescue Timothy Crt. dogstail Bluegrass R. S. Meadow gr. Red clover	Given L T V Found	1.10 1.42 1.41	18.15 21.88 18.81

195246	SYKESVILLE **Md. Mill. & Supply Co.** **The W. A. Simpson Co.**	**Not given**	Meadow fescue Bluegrass Red top	Given L T V Found	0.50 0.70 0.61	16.50 19.90 14.99
195186	WESTMINSTER Farmers Supply Co. Blamberg Bros.	Red top Bluegrass Meadow fescue	Red top Bluegrass Meadow fescue	Given L T V Found	2.20 2.74 1.04	16.00 19.20 15.95
195179	WESTMINSTER Farmers Supply Co. Wm. G. Scarlett & Co.	Timothy Alfalfa Alsike clover Red clover	Timothy Alfalfa Alsike clover Red clover	Given L T V Found	4.70 5.74 5.22	11.76 14.21 9.46
195180	WESTMINSTER Farmers Supply Co. Wm. G. Scarlett & Co.	Alfalfa Timothy Red clover	Alfalfa Timothy Red clover	Given L T V Found	3.85 4.72 3.96	13.84 16.71 16.30
195185	WESTMINSTER Farmers Supply Co. **Farmers Supply Co.**	Bluegrass Red top **White clover**	Bluegrass Red top	Given L T V Found	3.00 3.70 0.72	12.00 14.40 **16.35**

Summary of Purity Analyses of Samples of Special Mixtures (Section 102 of the Law).

The results of the purity analyses reported in Table IV are summarized in Table V. The number of samples tagged by any wholesale dealer is so small that the results reported in this summary are no more than suggestive when considered alone. Table V should be considered in connection with Table I. It should be borne in mind, also, that a very inferior sample may be found to be as represented.

Approximate composite samples of the lawn mixtures and of the pasture mixtures reported in Table IV are given below. A study of these composites should call attention to a number of interesting facts.

APPROXIMATE COMPOSITE SAMPLE OF LAWN MIXTURES REPORTED IN TABLE IV.	
Weed seeds	1.50
Inert Matter	20.50
Blue grass	27.50
Red top	26.50
Meadow fescue	7.00
Rye grass	5.50
Timothy	3.75
White clover	3.25
Miscellaneous	4.50
	100.00

APPROXIMATE COMPOSITE SAMPLE OF PASTURE MIXTURES REPORTED IN TABLE IV.	
Weed seeds	2.00
Inert Matter	11.10
Timothy	19.25
Blue grass	13.70
Meadow fescue	12.20
Red top	8.85
Rye grass	8.70
Alfalfa	6.50
Red clover	4.40
Orchard grass	2.15
Miscellaneous	11.15
	100.00

Table V.

SUMMARY OF TAGGING AND PURITY ANALYSES OF SAMPLES OF SPECIAL MIXTURES FOR WHOSE TAGGING THE WHOLESALE DEALER IS HELD RESPONSIBLE.

Name of Wholesale Dealer.	Address.	Number of Samples.	Per cent. tagged in accordance with the law in all respects.	Per cent. tagged in accordance with the law, and found to be within the limits of tolerated variation, for:			
				All Kinds of Seeds.	Weed Seeds.	Inert Matter.	All Kinds of Seeds, Weed Seeds and Inert Matter.
Blamberg Bros., Inc	Baltimore, Md.	3	100.0	100.0	100.0	100.0	100.0
J. Bolgiano & Son	Baltimore, Md.	6	66.7	66.7	66.7	33.3	0.0
J. J. Buffington & Co	Baltimore, Md.	6	16.7	0.0	16.7	16.7	0.0
Condon Bros	Rockford, Ill.	1	0.0	0.0	0.0	0.0	0.0
Griffith & Turner Co	Baltimore, Md.	3	33.3	0.0	100.0	66.7	0.0
Pen. Prod. Exchange of Md	Pocomoke City, Md.	1	0.0	0.0	0.0	0.0	0.0
Wm. G. Scarlett & Co	Baltimore, Md.	5	40.0	100.0	80.0	40.0	40.0
The W. A. Simpson Co	Baltimore, Md.	9	66.7	55.6	55.6	55.6	44.4
Whitney-Eckstein Seed Co	Bufflao, N. Y.	2	100.0	100.0	100.0	0.0	0.0
T. W. Wood & Sons	Richmond, Va.	1	0.0	100.0	100.0	0.0	0.0
Retail Dealers	Throughout Md.	22	81.8	36.4	63.6	59.1	22.7
All samples of special mixtures analyzed		59	62.7	47.5	62.7	47.5	23.7

WORK ON SUBMITTED SAMPLES.

There was an increase over the previous year of about 56 per cent. in the number of samples submitted to the Laboratory during the year. The most marked increase was in the number submitted by farmers for purity analyses and germination tests—approximately 300 per cent. Farmers might profitably make still greater use of the facilities of the Laboratory and thereby learn definitely whether the seeds they buy equal the claims made for them by the dealer. It should prove a great advantage to the farmer to know the per cent. of purity, weeds and germination of the seeds grown on his farm, or that of his neighbor, before planting them.

In addition to the purity analyses and the germination tests summarized in Table VI, four identifications were made and fourteen lots of tobacco seed were cleaned for farmers, and ninety germination tests were made for various departments of the College and the Experiment Station. There were a total of 821 samples submitted to the Laboratory during the year. The work on these samples may be summarized as follows:

4 identifications.
14 lots of tobacco seed cleaned.
327 purity analyses (practically all in duplicate).
773 germination tests.

Table VI.

SAMPLES OF SEEDS SUBMITTED TO THE LABORATORY FOR PURITY ANALYSES AND GERMINATION TESTS DURING THE YEAR 1919 BY WHOLESALE DEALERS, RETAIL DEALERS, CANNERS AND FARMERS.

	Samples.		Purity Analyses.		Germination Tests.		Purity Analyses and Germination Tests.	
	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
Wholesale dealers	172	24.13	143	43.72	156	22.83	299	29.61
Retail dealers	160	22.44	148	45.26	146	21.38	294	29.11
Canners	291	40.81	1	0.31	291	42.62	292	28.91
Farmers	90	12.62	35	10.71	90	13.17	125	12.37
Total	713	100.00	327	100.00	683	100.00	1010	100.00

University of Maryland
Agricultural Experiment Station

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THE RELATION OF CERTAIN GREENHOUSE PESTS TO THE TRANSMISSION OF A GERANIUM LEAF SPOT

Philip Garman.

During certain seasons of the year there appears in Maryland greenhouses devoted to geranium culture, a spot disease of the leaves which has been attributed to several causes by different authorities. Although noted in Maryland since 1909,[1] it was not until 1914 that it was brought to the attention of the College authorities in such a way that it was thought worthy of investigation. Rejection of a shipment of several thousand plants by the consignee resulted in an examination of the affected plants and the discovery of the cause of complaint, namely, severe insect stigmonose and a number of fungous troubles. One of the insects doing considerable damage was found to be the pallid mite, *Tarsonemus pallidus* Banks, which was made the subject of a previous investigation.[2] Accompanying this trouble was a spot disease[3] which it became advisable to study carefully in order to determine whether the presence of the spot and mite were related in any way.[4] The present paper, therefore, deals largely with the pathological side of the question, including control of the most important disease.[5] Several common insects other than the pallid mite have been included in the discussion principally because of their continued presence in the geranium houses concerned.

For convenience the spot will be known in this publication as the *circular spot.*

[1]Report Maryland State Horticultural Society, XII: 111: 1909.

[2]Maryland Agr. Exp. Station, Bul. 208: 1907.

[3]Identified by Mrs. F. W. Patterson, U. S. Dept. Agr., as **Cercospora brunkii,** Ellis and Galloway.

[4]This investigation is a continuation of a project entitled "The Biology and Economic Relation to Greenhouse Crops of Certain Mites."

[5]Approved for publication by Prof. J. B. S. Norton, Botanist and Plant Pathologist of the Md. Agr. Experiment Station.

Insects Commonly Associated with the Disease.[6]

Besides the pallid mite, red spiders, white flies and occasionally thrips, aphids and mealy bugs are to be found on geranium leaves. Red spiders and white flies are of most frequent occurrence and cause a much greater amount of stigmonose than can be attributed to the pallid mite. In fact, two different types of insect injury may sometimes be recognized, one caused by the pallid mite, and a second, caused by punctures of red spiders (Fig. 2C), white flies (Figs. 2E, 5), and mealy bugs. The latter type is a tuberculous form usually manifested by the appearance of small watery pimples upon the leaves, while that produced by the pallid mite consists of a scorching of the epidermis of the leaf usually without the production of pimples. Because of their infrequent occurrence on geraniums, thrips, aphids and mealy bugs have been disregarded in this paper as possible carriers of the circular spot disease.

Organisms Commonly Associated with the Disease.[6]

Botrytis species are so common in Maryland greenhouses and so constantly present on geraniums that their lesions may be mistaken for that caused by *Cercospora brunkii*. Spots caused by them are, however, usually much larger and frequently result in a characteristic sector disease involving a considerable area of the leaf. Other spots have been reported, but only a few have been observed in sufficient numbers to deserve attention. It will be well, however, to mention them.

Stone and Smith[7] in 1897 reported a bacterial disease causing spots on geraniums in Massachusetts. More recently Lewis[8] isolated a similar organism and described its cultural and morphological characteristics. A bacterial spot (Fig. 7A) was first obtained in Maryland in November, 1918, and at this time was found to be doing considerable damage to S. A. Nutt geraniums. It was not found to be as widespread, however, as the circular spot, but, like the latter, was no more destructive where the pallid mite was found than elsewhere. The organism discovered by Lewis is not spread by insects, according to that author, but largely by watering methods, and should be controlled by exercising care in this particular. In the Maryland greenhouse where the bacterial spot was obtained, white flies were present and watering was done with an ordinary hose without nozzle.

Several rusts have been described, as well as a little-known Alternaria spot recently reported from Michigan. A spot caused by a fungus of the genus Macrosporium is also known, but all of these are, for the most part, weak parasites which occur occasionally throughout a greenhouse.

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[6]For a general discussion of the subject see Chifflot, M. J., Journ. Soc. Nat. Hort. France, s. 4e, t. 8: 348-355: 1907.

[7]Mass. Hatch Sta. Report, 1897: 47-70 and 1899: 56-73.

[8]Lewis, I. M., Phytopathology, IV: 221-232: 1914.

The Disease and the Causal Organism.

Spotted geraniums are most numerous in commercial houses in spring about the time that firing is discontinued, and in fall just before firing is begun. Atmospheric conditions within the houses at these times frequently combine a high relative humidity with a low temperature. At such times the spots become numerous enough to attract at-

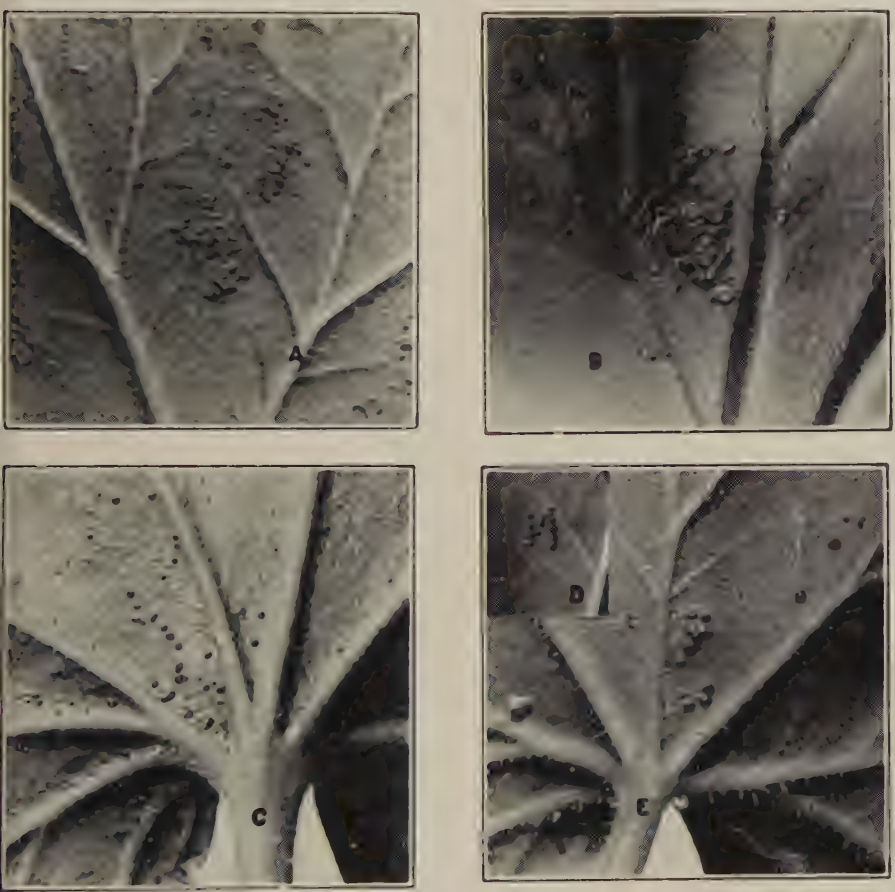

Fig. 2—Artificial and Insect Stigmonose, and Circular Leaf-spot.

A. Effect of exposure to ammonia fumes.
B. Leaf-spot caused by *Cercospora brunkii.*
C. Red spider stigmonose.
D. Artificial stigmonose produced by puncturing a leaf with a fine needle.
E. White fly stigmonose.

tention and may injure the sale of plants because of the unsightly appearance. Stock beds harbor the disease almost continuously, but a marked increase in the number of affected plants usually occurs at the above stated periods. In this climate at least lack of ventilation is one of the chief factors responsible for the spot, a fact judged from the difficulty in propagating the disease in small houses and from its relative scarcity in houses where good ventilation is provided.

Ellis and Galloway[9] described the spot and fungus in 1892 from Brazos County, Texas, "on cultivated geraniums." The description follows:

"Spots amphigenous, light brownish or pale brick color, orbicular or oval, ¾-2¼ millimeters in diameter, with a narrow, slightly raised, and rather darker border, which is more prominent on the lower side of the leaf. Hyphæ amphigenous, but more abundant below; pale brown, 90-200 by 3-5 μ, subgeniculate, 2-5 septate, forming loose spreading tufts of 5-6 (rarely more). Conidia clavate-cylindrical, hyaline, multiseptate (5-20), 50-125 μ long, 3-4 μ thick (at the lower end). Differs from *C. geranii*[10] in its darker hyphae and more numerous septa, its larger multiseptate conidia and the raised border of the spots."

The fungus grows well on several media, but does not produce spores readily on any of them. Sterile cornmeal is apparently best suited to spore production, but few are produced even on this medium. On nutrient beef agar (1.5%, reaction + 1), the mycelium is frequently quite black and dense and concentric rings are formed. Growth is slow at room temperature and "colonies" in petri dishes often require several weeks to reach the diameter of a half inch. On vegetable agars (Fig. 3) such as beet, celery and bean, the growth is likewise slow, and is characterized by a slate olive color imparted to the mycelium. On cornmeal the growth is slate color to white, and the aerial growth develops spores as well as small black bodies resembling perithecia. Mycelia on sterile carrot blocks is a characteristic olive green. On Irish potato, sterile macaroni and geranium stems, a grayish olive color prevails.

The mycelium produced on agar cultures is dark smoky brown and multiseptate, the threads sometimes presenting a yeast-like appearance due to lateral irregular projections on the different segments. The diameter of swollen cells found beneath the surface of the media may reach 7 μ, while the length is usually about twice this. The aerial mycelium is much more slender and single threads are about 2.5 μ in diameter.

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[9]Journal of Mycology, VI: 33: 1891.

[10]Chifflot (loc. cit.) states that some authors combine **brunkii** and **geranii**.

Fig. 3.—Culture of *Cercospora brunkii*, the geranium leaf-spot organism, on carrot agar; age of culture, one month, 14 days.

Spots produced on infected leaves (Figs. 4, 5) vary from about a millimeter in diameter to several millimeters. Infected areas examined by transmitted light are characterized in the early stages by the appearance of small dark opaque spots, which are later surrounded by a raised transparent border. Still later the spots may become united and occupy a considerable area of the leaf. They are usually light brown in color, but are sometimes almost black.

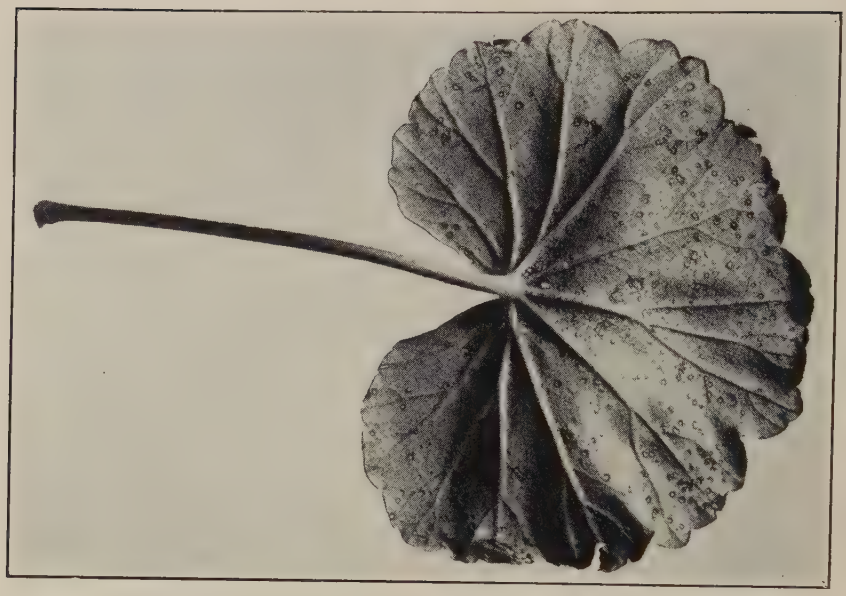

Fig. 4.—Natural Infection of a Zonal Geranium with Cercospora Leaf-spot.

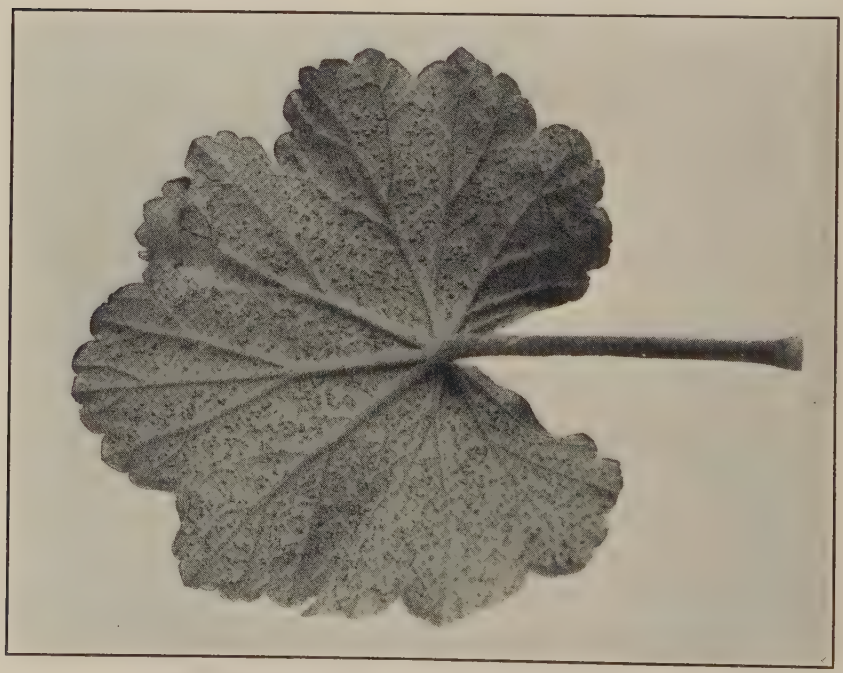

Fig. 5.—Stigmonose Caused by White Fly Punctures.

Isolation of the Fungus and Production of the Spot with Pure Cultures.

Cultures from infected leaves made in 1917, and again in 1918, showed the frequent presence of two different fungi. Botrytis spp. were obtained, but somewhat more frequently another type, characterized by slow growth and dense compact mycelium. In cultures this fungus often radiated from the spot itself, and, as shown later, is really the cause of a spot disease. Successful methods of isolation consisted in dipping the leaf in 70 per cent. alcohol and removing immediately to a 1-1000 solution of mercuric chloride, in which it remained 4-5 minutes, being then rinsed in sterile distilled water and plated in nutrigent agar. The following test experiments show that the fungus suspected is capable of producing the disease and that the ordinary Botrytis is incapable of producing the characteristic spots.

November 28, 1917. Three cuttings fumigated with hydrocyanic acid gas (using ½ oz. NaCN to 1000 cu. ft.) for 12 hours were sprayed with an infusion of Botrytis spores isolated from the stem of geranium. The plants were grown in a flat containing nine others and were covered with glass cylinders having muslin tops. Inoculations were made by spraying an infusion of spores and mycelium in distilled water from a sterilized atomizer. On December 12 and later there could be found no spots on the leaves. Three check plants covered with cylinders, but unsprayed, showed no disease at the end of the period.

January 7, 1918. Four plants free from insects of all kinds were selected. Two were sprayed with an infusion of *Cercospora brunkii,* all plants being covered with bell jars. January 23, both sprayed plants showed decided spots of typical form; a check plant was noted with a sector disease on one leaf, but this and other check plants were without typical spots.

January 16, 1918. Four gereniums in a flat, fumigated with HCN (using ½ oz. NaCN to 1000 cu. ft.) were brought to the laboratory and covered with sterile glass cylinders. Two were selected and sprayed with Cercospora infusion from a sterile atomizer, two being left without treatment. January 26, 33 distinct spots were seen on sprayed plants; no spots on the unsprayed. Isolations made from spots produced a fungus similar to the original used.

February 14, 1918. A flat containing nine geraniums in healthy condition was sprayed with a Cercospora infusion in distilled water; checks afforded by a similar flat and numerous other plants in beds alongside. All plants were kept in a greenhouse. March 11, five of the plants that were sprayed were found to be infected and showing spots, one leaf with 17 spots in all. Nine plants in a bed alongside were found without a single infected leaf, as were also those in the check flat.

March 26, 1918. Two beds of geraniums in a greenhouse were sprinkled with an infusion of Cercospora spores made by shaking two petri dish agar cultures in about one-half gallon distilled water, the infusion being applied with a clean, but not sterile sprinkling can.

Plants of various sizes were used, up to one foot in height. April 13, small spots appeared in considerable numbers on the leaves after a week of cool, cloudy weather, several plants showing as high as four infected leaves. In one of the beds 15 plants of a total of 30 were infected. April 23, one of the beds with 30 plants showed a total of 28 infected ones, the other containing 20 plants showed 14 to be infected. As a check to this experiment a bed was selected containing 36 plants similar to those of the treated beds and in approximately the same location as regarded light, heat, etc. April 13, no spots could be found in the check lot, and the same was found to be true on April 23.

Examination of the Evidence Against the Various Insects Infesting Geranium Plants.

The most important insects associated with the circular spots are the pallid mite, white fly and red spider. These insects will be considered one at a time in order to show their ability to transmit the circular spot. The pallid mite seems to be the least important of the three insects mentioned with the red spider next. White flies do not as a rule infest zonal geraniums, but their preference for the Martha Washingtons and the rather frequent occurrence of the circular spot on infested plants of this type has caused it to be strongly suspected as a carrier.

The following possibilities in transmission of the circular spot have been considered for each of the three insects:

I. The insect may harbor the parasite within the body.
   1. The insect may harbor the parasite until its death, when it may escape and enter the leaf tissues.
   2. The parasite may be passed out with the feces and enter the leaf through wounds or pores.
   3. The parasite may be introduced directly through the mouth opening at the time of puncturing.

II. The insect may carry the parasite attached to the outside of the body.

III. The parasite may be carried by other agencies and enter the leaf through punctures or wounds left by insects.

The Pallid Mite as an Agent Transmitting the Circular Spot.

Injury to geranium plants by the pallid mite is characteristic and appears as small patches which have been scorched, but are still green. In other cases the leaves may appear to have mosaic, but affected leaves have not been noticed to develop symmetrical spots such as are produced by Cercospora infection. After studying the type of injury caused by this insect it was found fairly easy to determine whether or not the

pest was present in a given bed. Consequently several surveys were made of greenhouses where the spot occurred, with the result that large areas of cultivated geraniums were seen in which the spot was prevalent, but in which no Tarsonemus or pallid mite could be found. Occasional beds were found in which the mites were indeed destructive, but here it was noted that spots were no more numerous than in other parts of the house.

The fact that injury caused by the pallid mite is spread more or less evenly over the surface of the leaf and includes only the epidermis, seems to preclude the possibility of infection through the injury left by the insect.

However, on November 11, 1918, several dozen mites confined for a day on a geranium leaf with characteristic spots were transferred to a healthy leaf kept isolated and placed under a cage provided with 50 mesh wire. Checks were provided and kept outside of the cage. December 5, no spots of any kind were seen on the infested plants or on the checks.

Important evidence tending to disprove the possibility of the agency of this insect is apparent upon studying its mouth-parts. Measurements of the mouth opening shows a diameter of about .7 μ, whereas the minimum diameter of a single filament or spore of Cercospora is 2 μ. It may thus be seen that the insect is incapable of harboring the parasite within the body cavity. To this may be added the fact that the mite is not capable of puncturing the leaf, and if capable, could not produce an opening of sufficient size to allow the fungus to enter.[11] The absence of piercing stylets, too, is noteworthy, there being nothing similar to those of the red spider. The length of the effective portion of the lingua (that portion which could be used for puncturing) is not over 1.0 μ in length, whereas the thickness of the outer cell wall of the epidermis of a geranium leaf is commonly as much as 1.4 μ. Even assuming that the organ might be thrust through thin portions of the cell walls, the diameter of this opening would in all probability not exceed 1 μ, the diameter of the piercing organ of the mite being about .7 μ at tip. Pallid mites are not, therefore, apparently able to harbor the fungus within the body or to provide an entrance point for it if carried by other means.

As a partial summary it may be stated that the pallid mite is evidently not responsible for the spread of the type of leaf spot caused by *Cercospora brunkii,* because:

1. Morphological data indicate that the mite can only serve as a mechanical carrier and that the punctures made by it would not be sufficiently large to afford an entrance point for the fungus if carried by other means.

[11] It is true, however, that decayed tissues following insect injury of this kind might afford a suitable point of development for the fungus if deposited thereon, but the injury in this case is such that little decayed tissue results unless a large number of mites are present, and then a hardening takes place, tending to exclude fungi rather than favor their development.

2. Direct transfer of mites from infected to uninfected plants fail to produce the disease.

3. The spot and mite are not always directly associated, the disease flourishing in beds of geraniums not infested by this species. In infested beds there is no more and often not as much disease as elsewhere.

4. The disease is easily produced with pure cultures in the absence of pallid mites.

The Red Spider as an Agent Transmitting the Circular Spot.

Injury from red spider punctures consists of minute tubercles. Such injury is more frequently seen than the typical pallid mite injury and red spiders are generally more common than pallid mites. Spots caused by Cercospora are similar to the injury due to red spider punctures, and if not studied with care may be confused with them. Typical Cercospora spots are nearly circular in outline, with a raised border (Figs. 2B, 6 and 7), the elevated rim being particularly noticeable in dead leaves. Diseased or dead areas that sometimes follow red spider punctures are more or less angular and without the raised border. Greenhouses where the spot is prevalent, however, often have red spiders in fair abundance and spotted leaves may frequently be found to have been infested by them.

Fig. 6.—Artificial Infection of a Geranium Leaf with Cercospora Leaf-spot.

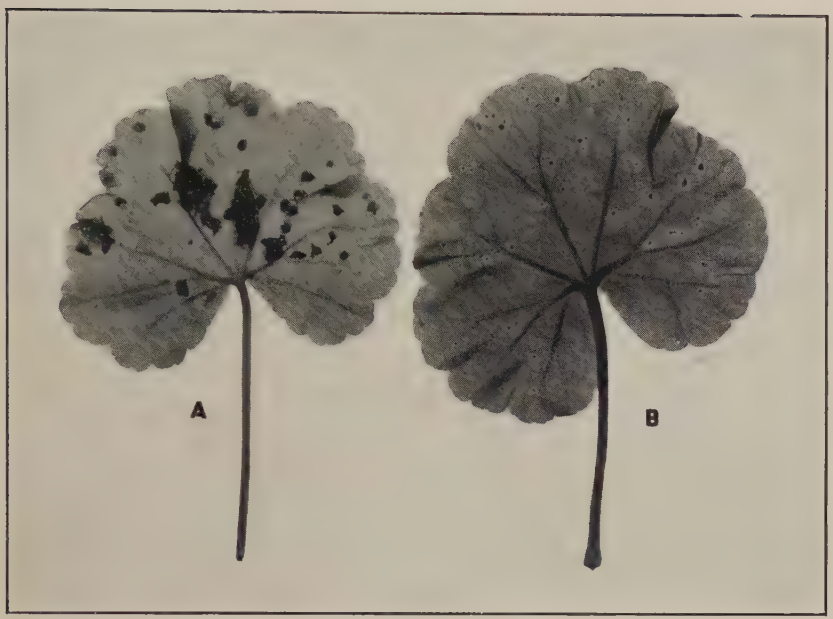

Fig. 7.—A comparison of the Geranium Leaf-spot caused by Bacteria (A), and that caused by the fungus *Cercospora brunkii* E. and G. (B). Photographed by transmitted light. Natural infection.

The tubercle resulting from a red spider puncture seems to be due to mechanical irritation of some sort and not to the presence of disease organisms.[12] In fact, the primary effects of the entrance of fungous mycelium is very different, and the two may be distinguished if examined by transmitted light. To prove the "mechanical" nature of the hypertrophy following insect punctures of the type caused by red spiders and white flies, a dissecting needle was filed to a fine point, and after passing through a bunsen flame and dipping in distilled water, was used to puncture a young geranium leaf. Fig. 2D shows the effect of this treatment and should be compared with 2C, which is an enlarged photograph of a red spider puncture. Still further evidence is afforded by the use of ammonia fumes, as seen in 2A,[13] and such facts

[12]The absence of disease organisms has been demonstrated for carnations by Woods, Bul. 19, U. S. D. A. Div. Veg. Phys. & Pathology, 1900.

[13]Exposure for 20 minutes to fumes of .5 cc. of ammonia. Capacity of the bell jar used, .63 cu. ft., or .0178 cu. m

prove that the tubercular stigmonose of the kind which follows insect punctures may be produced with or without the introduction of chemical irritants and without the introduction of disease organisms.

That the disease does not enter old punctures is shown by the following experiments: Several plants were selected from a bed in which both red spider and white flies had been numerous, but from which both had disappeared shortly before. The plants selected were free from all insects at the time of the test, but had marked stigmonose. Bell jars were placed over single plants and the leaves on these plants labelled and diagrammed so as to fix the location of the insect punctures. The plants were then sprayed with an infusion of Cercospora, February 14. On March 1 the condition of the leaves was again noted and the resulting spots placed on the diagram. The result is seen in Fig. 1, E-F. It will be noted that spots are fully as numerous on portions of the leaves free from punctures as are found among or near the punctures themselves.

An attempt was also made to obtain evidence of the power to transmit the disease by transferring several dozen red spiders from a spotted leaf to a healthy unspotted one. Checks were afforded by transferring red spiders from an eggplant to two different geraniums, keeping one under protection of a 40-mesh screen and the other without protection, as well as by keeping a similar plant entirely without treatment or infestation. The experiments were begun November 3, 1918, and on December 5 no spots had appeared on any of the leaves. Similar tests were conducted at different periods with the same result.

The piercing organs of the red spider consist of two long sharp stylets strongly curved at the proximal end. These stylets are sometimes 50 μ in length, and the diameter of each varies from 1.5 μ at the tip to about 2.2 μ at the middle. It is possible, therefore, for the insect to effect a puncture measuring 3-3.4 μ in diameter by using both stylets together. However, it must be kept in mind that there is no beak which may be inserted, and consequently no means of introducing the fungus directly. Furthermore, the puncture must naturally close somewhat after the stylets are withdrawn, thereby lessening the possibility of an entry of the fungus after the insect has abandoned it. Compared with the opening afforded by stomata, which in geraniums may measure 20-30 μ by 3-7.5 μ under suitable atmospheric conditions, the possibility of entrance through punctures of the sort made by the red spider is indeed small.

To summarize: The red spider does not seem capable of transmitting the geranium leaf-spot caused by *Cercospora brunkii* because:

1. Morphological data indicate that the punctures left by red spiders could hardly serve as entrance points for the fungus and would in all probability not be as suitable as the openings of stomata, which are larger and more numerous.

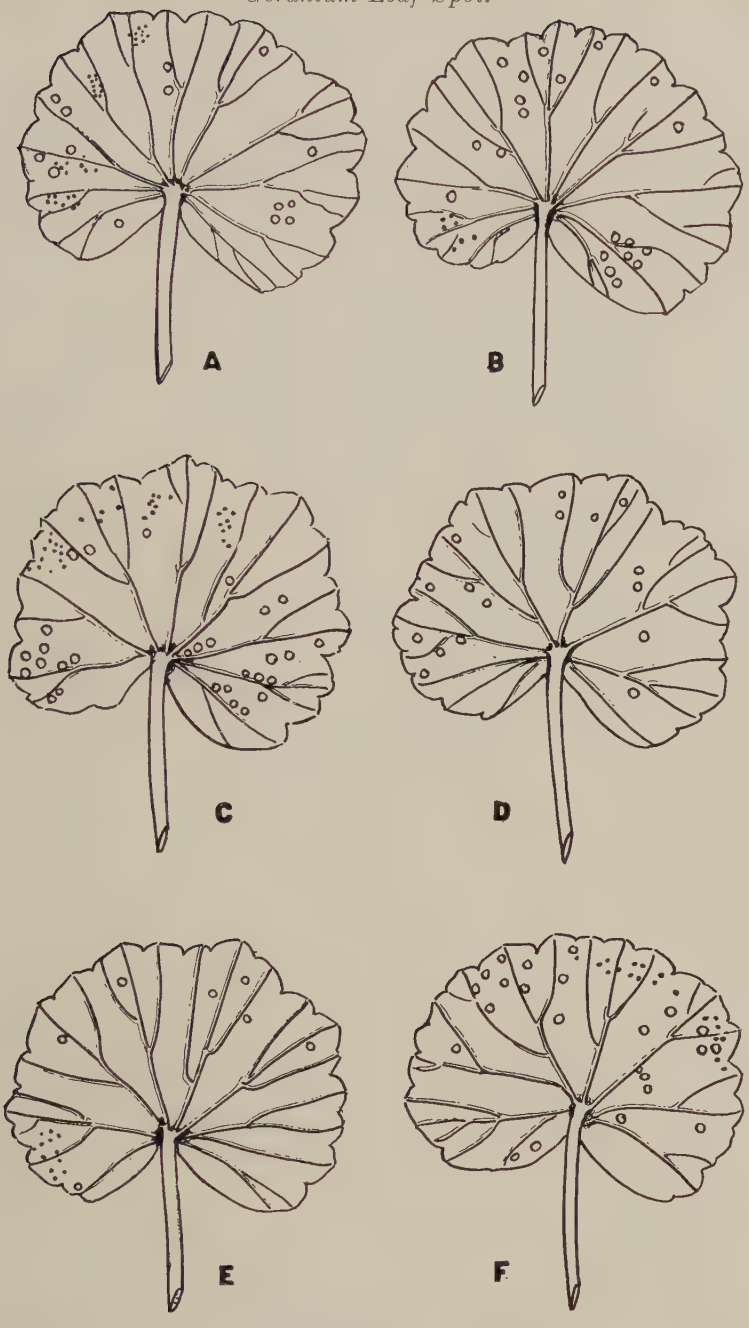

Fig. 1.—Results of Spraying Geranium Leaves with an infusion of *Cercospora brunkii.*

A-D. White fly punctures represented by small dots; leaf-spots as they appeared two weeks later represented by small circles.

E-F. Red spider punctures represented by dots; leaf-spots appearing two weeks later by small circles. About 2/5 natural size.

2. Microscopical examination of red spiders from infected plants show no signs of the fungus, and cultures with mites from infected leaves are negative.

3. Experimental data indicate that the fungus does not enter punctures of the kind made by red spiders after they are abandoned by the insect.

4. Direct transfers of red spiders from infected to uninfected beds fail to produce the disease.

5. The disease is easily produced with pure cultures of *Cercospora brunkii* in the absence of red spiders.

The White Fly as an Agent Transmitting the Circular Spot.

The mouth parts of white flies are much better suited for the transmission of the circular spot than those of either the red spider or pallid mite. The diameter of that portion of the labium or rostrum used for puncturing is 10 μ at the tip and about 37 μ at the base of the distal joint. The piercing stylets are 2.5 μ in diameter. It is thus to be seen that the possibilities of transmitting the disease are much greater than for either red spider or pallid mite. However, the fungus has not so far been recovered from white flies fed on infected leaves nor have direct transfers of flies from infected to uninfected leaves caused the spot to appear. Flies confined over pure cultures for half-hour periods and longer failed to carry it to plants on which they were liberated. To prove that the fungus does not enter punctures left by the white fly, experiments were conducted similar to those for the red spider. The smaller dots of Fig. 1, A-C, represent punctures left by white flies on February 14, 1918. Diseased spots which appeared March 1 following an application of Cercospora infusion on February 14 are represented by small circles. It will be noted again that spots are fully as numerous on portions of the leaf free from punctures as are found among or near the punctures themselves. Fig. 1D, a check leaf without insect punctures possessed 16 characteristic spots, as shown in the diagram.

Still another test in 1919 gave negative results. Eleven plants were cut back until nothing remained except an inch of stem and the roots, all leaves being thereby removed. These plants were then placed under a cloth cage made of a very fine lawn, and new leaves allowed to grow out. Examination from time to time showed a total absence of insects or injury from insects, and absence of circular spots. One plant was sprayed January 11 with a Cercospora infusion and covered with a bell jar for a few days. Circular spots developed on this plant, nearly

all of the leaves being affected and two of them dropping from the stem. The spots were still in evidence on this plant February 24, when four of a total of ten leaves were infected. Between January 11 and 24 and thereafter until the end of the experiment large numbers of white flies were liberated on the plants and allowed to feed on the infected ones. They were afterwards driven to the uninfected plants. The experiment was allowed to run seventy days, on the expiration of which time a detailed examination resulted in obtaining 59 spots on leaves 5-8 inches from the infected plant, 24 spots on leaves 8-12 inches away and 8 spots on leaves 12-18 inches from the infected plant. The results are best seen in the tabulation below, which may be compared with results obtained in similar cages without white flies. In this case 68 per cent. of the infected leaves bore evidence of white fly attack, while from a total of 79 leaves 26 (32%) showing evidence of white fly punctures were infected with circular spot.

TABLE 1—SHOWING RESULTS OF AN ATTEMPT TO TRANSMIT THE CIRCULAR SPOT BY MEANS OF WHITE FLIES.

	Total number of leaves on plants.	*Number of leaves infected with circular spot.*	*No. of uninfected leaves.*	*Per cent. of infected leaves.*	*No. of leaves with white fly punctures.*	*No. of leaves without white fly punctures.*	*Per cent. of leaves with white fly punctures.*	*Total number of typical spots observed.*	*No. of spotted leaves with white fly punctures.*	*No. of spotted leaves without white fly punctures.*	*Per cent. of spotted leaves with white fly punctures.*
Condition of leaves 5-8 in. from plant artificially infected.	62	19	43	30.6	43	18	69.3	59	13	5	68.4
Condition of leaves 8-12 in. from plant artificially infected.	34	13	21	38.2	9	11	26.4	24	8	5	61.5
Condition of leaves 12-18 in. from plant artificially infected.	54	6	48	11.1	27	24	50.0	8	5	1	83.3
Totals.....	150	38	112	25.3	79	53	52.6	92	26	11	68.4
Condition of plant artifically infected...	16	9	7	56.2	15	1	93.7	170	8	1	88.8

Two check plats were employed, both without insects. One was treated by watering with a garden hose without nozzle, the water being driven through the infected plant to the uninfected ones. The second check consisted of a number of cuttings sterilized by dipping in 1-1000 mercuric chlorid after removing all leaves and planted in sterile soil. This lot received all their water supply from below, and a source of infection was provided by introducing an infected plant from another cage free from insects.

The results of the check tests are seen in Tables 2 and 3.

TABLE 2—SHOWING RESULTS OF AN ATTEMPT TO SPREAD THE CIRCULAR SPOT BY WATERING.

	Total Number of Leaves.	*Number of Infected Leaves.*	*Number of Uninfected Leaves.*	*% of Infected Leaves.*	*Number of Typical Spots Observed.*
Leaves 5-8 in. from plant artificially infected.	72	41	31	56.9	290
Leaves 8-12 in. from plant artificially infected.	48	18	30	37.5	115
Leaves 12-24 in. from plant artificially infected.	101	45	56	44.5	158
Totals	221	104	117	47.0	563
Condition of plant artificially infected.	28	20	8	71.4	280

TABLE 3—SHOWING THE SPREAD OF THE CIRCULAR SPOT IN ABSENCE OF INSECTS.

	Total No. of Leaves.	*Number of Infected Leaves.*	*Number of Uninfected Leaves.*	*% of Infected Leaves.*	*Number of Typical Spots Observed.*
Leaves 5-8 in. from plant artificially infected.	47	17	30	36.1	49
Leaves 8-12 in. from plant artificially infected.	60	17	43	28.3	38
Leaves 12-24 in. from plant artificially infected.	149	37	112	24.8	84
Totals.	292	96	196	32.8	171
Condition of plant artificially infected.	36	25	11	69.4	120

In all experiments a number of leaves were selected at random and examined with the miscroscope. Cercospora spores and mycelia were found in nearly all cases examined. It will be noted that spots were more numerous in the lot where water was applied directly to the leaves (Table 2) than in cases where the water was supplied from below (Tables 1 and 3). The presence of white flies did not make an appreciable difference in the number of spots (compare Tables 1 and 3).

To summarize: The white fly does not seem able to transmit the geranium leaf spot caused by *Cercospora brunkii,* because:

1. Microscopical examination of white flies and cultures from flies fed on diseased leaves are negative.

2. Direct transfers of flies from infected to uninfected leaves fail to produce the disease.

3. The rate of spread of the disease is not materially increased by the presence of a large number of white flies.

4. The disease is easily produced with pure cultures in the absence of white flies.

The Probable Method of Transmission of the Circular Spot.

To determine the probable method of transmission of the leaf spot an experiment was conducted as follows: April 29, 1918, a bed containing about 30 geraniums previously inoculated with Cercospora leaf spot was selected. Ninety-five per cent. of the plants were infected. Four of the plants in the middle of the bed were then removed and healthy plants without spots or insects substituted, the introduced plants being treated in several different ways. For instance, plant (a) was kept in a glass cylinder, the top of which was protected with muslin, and was covered when watering with a glass plate. This plant was further protected by placing in an insect breeding cage provided with 40 mesh wire. Plant (b) was placed in a similar breeding cage provided with 40 mesh wire, but did not have the protection of a glass cylinder. Plant (c) was left without protection of any sort. Plant (d) was protected with a large bell jar only when watering. Watering was done with an ordinary hose, a stream being driven parallel to the surface of the bed and through the infected plants to the newly introduced ones. Plants (a) and (d), of course, were protected from such treatment and received their water supply from below. Special attention was paid to driving the spray through the cage protecting plant (b) and onto the enclosed plant. On May 19 an examination revealed spots on several plants as follows: Plant (c) had six well-defined and characteristic spots; plant (b) had 16 well-defined and characteristic spots; plants (a) and (d) had no spots.

A comparison of Tables 2 and 3 is interesting in this connection because of the large increase in the number of spots in the case where the leaves were sprinkled, thus indicating that one of the principal means of transmission lies in the method of watering.

Experiments in Control of the Circular Spot.

On July 3, 1918, five beds of geraniums were selected and isolated from one another by placing muslin screens between them to prevent splashing when watering. The beds contained 21-25 young plants each, and were designated as a, b, c, d and e. Bed (a) remained without treatment; (b) was treated with an infusion of Cercospora spores and mycelium, made by shaking a petri dish culture in a gallon of tap water, the infusion being applied with an ordinary sprinkling can; (c) was treated with the same infusion of Cercospora, and in addition was dusted with Grasselli's bordeaux and arsenate of lead shortly before treatment with the infusion; (d) was treated with the infusion of Cercospora, but was also sprinkled shortly before with lime sulphur diluted 1-80 with the addition of casein lime enough to insure good spreading on the leaves; (e) was treated with commercial bordeaux mixture (paste diluted 1-10) before applying the infusion of fungus. Bed (e) contained older plants than the other beds, but presented admirable conditions for development of the spot because of the number of leaves and crowded condition of the plants, many of them being in actual contact. The following table gives the results of detailed examinations of the plants made on June 17 and July 17.

TABLE 4—SHOWING RESULTS OF CONTROL MEASURES FOR THE CIRCULAR SPOT.

Treatment Received.	Designation of bed.	Number of Plants Used.	Number of Leaves Spotted.	Number of Plants Infected.	Number of Spots Counted.	Total No. of Leaves on Plants.	Date.
None.	a	21	4	4	6	90	6/17
			37	11	376	203	7/17
Fungus infusion.	b	20	35	13	111	201	6/17
			139	20	2,230	387	7/17
Fungus infusion plus bordeaux dust.	c	21	12	5	53	287	6/17
			21	8	103	398	7/17
Fungus infusion plus lime-sulphur.	d	24	19	8	103	139	6/17
			30	17	325	225	7/17
Fungus infusion plus liquid bordeaux.	e	25	4	2	10	500	7/17

Further tests made in the winter of 1919 gave similar results, which, although not as decisive, show what effect the treatments suggested will have in reducing the circular spot.

TABLE 5.—SHOWING RESULTS OF CONTROL MEASURES FOR THE CIRCULAR SPOT.

Treatment Received.	Number of Plants Used.	Number of Leaves Spotted.	Number of Plants Infected.	Number of Spots Counted.	Total Number of Leaves.	Date.
Lime sulphur plus fungus infusion.	21	6	5	12	131	2/20
		29	13	99	167	3/20
Fungus infusion.	17	13	9	19	118	2/20
		31	12	62	136	3/20
Bordeaux (4-4-50) plus fungus infusion.	20	1	1	1	123	2/20
		4	4	5	143	3/20
None.	17	0	0	0	102	2/20
		15	9	51	227	3/20

It will be noted that of the fungicides used bordeaux mixtures proved to be the best preventives. Check plat (a), Table 4, was located near a previously infected bed in which there was considerable leaf-spot, but was separated from it by a cloth screen. The treatment with bordeaux dust is promising but cannot be as highly recommended as liquid bordeaux. Lime sulphur 31° as dilute as one part to 100 parts of water will cause slight burning of the leaves and cannot be recommended for general use.

A simple method of treatment which affords a measure of protection from diseases (and also insects), especially those spread by the handling of cuttings and by cutting bench practices, is to be had in the dipping of all cuttings just before setting out. Such treatment will prevent the spread of the circular spot and at the same time will destroy those insects which are injurious. To test the possibility of such treatment, especially the effect upon the plants themselves, a number of cuttings were dipped in bordeaux and planted out after the preparation had dried on the leaves and stems. Of ten cuttings treated in this manner with 4-4-50 bordeaux during March, 1917, nine rooted and developed normally. By May 2 four cases of stem rot appeared in a check untreated lot, planted at the same time, only one appearing among the cuttings dipped in bordeaux. The cuttings were made in two-inch pots in light sandy loam, such as is sometimes employed in commercial houses. Results of this and other similar tests are shown in Table 6. The house was purposely kept moist during the rooting period so that such diseases as might be present would have a chance to develop. Cuttings dipped in bordeaux did not root quite as freely as undipped plants (that is, fewer roots were produced per cutting) but gave, as a rule, more vigorous plants after removal from the cutting bench. 4-4-50 bordeaux mixture was used in all tests and no injury could be seen as a result of any of the treatments either to stem or leaves.

TABLE 6—SHOWING RESULTS OF DIPPING GERANIUM CUTTINGS IN BORDEAUX MIXTURE AFTER REMOVAL FROM THE STOCK PLANTS.

Treatment.	Date of Treatment.	Number of Cuttings Used.	No. Rooted After 1 Mo. 2 Wks.	No. Rooted After 2 Mos.	% Rooted.	No. of Cases of Stem Rot Observed.	No. of Leaf Spots Observed.	Method of Handling Cuttings and General Notes.
Bordeaux: dipped and planted after drying.	March, 1917	10	...	9	90	1	...	Cuttings made in light sandy loam in 2-inch pots.
Cuttings planted without treatment.	March, 1917	10	...	6	60	4	...	Cuttings made in light sandy loam in 2-inch pots.
Bordeaux: dipped, dried and planted.	Nov. 9, 1918	25	14	16	64	7	0	Cuttings made in pure sand.
Bordeaux: dipped, dried and planted.	Nov. 9, 1918	25	14	15	60	6	0	Cuttings made in pure sand.
Cuttings planted without treatment.	Nov. 9, 1918	28	12	17	60	8	9	Cuttings made in pure sand.
Bordeaux: immersed ½ hour and planted without drying.	Jan. 12, 1919	50	23	38	76	3	...	Cuttings made in pure sand.
Cuttings planted without treatment.	Jan. 12, 1919	10	6	6	60	2	...	Cuttings made in pure sand.
Dipped in Cercospora infusion alone.	Mar. 3, 1919	19	18	...	94	0	About 350	Considerable care exercised in making cuttings.
Dipped in Cercospora infusion, then bordeaux.	Mar. 3, 1919	19	17	...	89	2	5	Considerable care exercised in making cuttings.

Conclusions.

1. The geranium leaf spot is caused in part by a true fungous parasite, *Cercospora brunkii* E. & G.

2. Stigmonose is caused by several insects, the most common of which are red spiders and white flies. The injury caused by them may be distinguished from the spot caused by the fungus.

3. One of the principal means of spreading the Cercospora spot lies in the method of watering. Insects play a small part, if any, in the transmission of the disease.

4. Control of the spot may be obtained by applications of bordeaux mixture to the stock beds and cuttings. Fungicides other than bordeaux have not proved as successful as this mixture.

5. Discolored foliage resulting from fungicide applications may be largely avoided in plants ready for shipment or setting out in beds, if the cuttings are dipped in bordeaux soon after removal from the stock plants. Plants so treated will grow out of the marks of the application by the time they are ready to ship or set out.

6. Good ventilation should be provided wherever possible and every precaution taken to prevent excessive humidity or dampness.

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INTERNAL FUNGOUS PARASITES OF AGRICULTURAL SEEDS

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SUMMARY.

1. A review of the literature shows that a number of internal parasites have been reported in seeds of the following crops: Barley, beans, beet, bur clover, cabbage, clover, corn, cotton, cucumber, darnel, evening primrose, flax, grasses, hollyhock, pea, rice, sweet corn, timothy, tomato and wheat.

2. The morphological structures of the pathogens, in which they are reported to be carried within the seed, are: oospores of the Phycomycetes, uredo and teleutospores of the Uredinales, vegetative forms of bacteria, vegetative mycelium of fungi, "mycoplasma," and unknown forms.

3. It is recorded that pathogens introduced into seeds may enter the ovary with the pollen tubes, or grow into the seed through the tissues of the fruit.

4. Agricultural seeds collected from both diseased plants and healthy plants, seeds having diseased symptoms and seeds of normal appearance were used in the experiments herein reported.

5. A technique of sterilizing the seeds externally with an alcoholic solution of corrosive sublimate and of growing the sterile seedlings in test tubes with cotton saturated with nutrient solution and in agar plates has been developed for studying the internal seed-borne pathogens.

6. Washing the seeds in sterile water after treatment with alcohol has been found absolutely necessary in order to prevent the alcohol from injuring the seeds.

7. A species of *Cylindrophora* was isolated from sterilized asparagus seed.

8. *Alternaria sp.* was found in the seeds of cabbage.

9. Species of *Fusarium, Macrosporium* and *Alternaria* have been isolated from common beans which were sterilized externally. A species of bacteria, which gave a coral red colored pigment was also noted in the bean cultures.

10. A species of *Macrosporium* causing a rusty appearance on the roots of cowpea seedlings was observed.

11. Externally sterilized lima beans were found to be infected with a species of *Fusarium.*

12. Species of *Macrosporium* and *Fusarium* have been isolated from externally sterilized soybeans.

13. A fungous parasite of sweet corn seedlings was observed. It appears to be identical to *Oospora verticillioides* as described by Saccardo, which may be a conidial stage of a better known corn parasite.

14. The mosaic of tomato was not found to be transmitted through the seed.

15. *Rhizopus nigricans,* Ehr. was isolated from dark colored seeds of rotten tomato.

16. A sterile fungus was noted to be parasitic to wheat seedlings.

17. Seeds of barley, alfalfa, timothy, red clover and crimson clover were tested but no pathogens found.

18. Seed selection from disease-free plants, germination test, and hot water and hot air treatment of seeds are suggested as means for controlling internal parasites of seeds.

INTRODUCTION.

The problem of sowing healthy seed for the production of good crops has attracted considerable attention from various points of view for many years. However, the relation of internal seed infesting pathogens to the reduction of crop yields has not been generally recognized.

Some plant diseases most dreaded in farm crops are among those carried within the seed. Many of them have attained as wide distribution as the hosts themselves due to their concealment within the seed. There is no doubt that poor germination of seeds, missing plants in the field, shriveled grains, dying of young seedlings, poor yields, and dwarfing of plants are largely due to the action of pathogens which have infected the seed internally.

In the present Bulletin it has been the purpose to bring together and summarize the findings of previous investigators upon the subject, to develop a technique by which further studies can be easily carried out, and to add something from observations and experiments. Many difficulties have confronted the writer during the investigation, because our

knowledge of internal seed infesting pathogens is quite recent and also because no extensive or systematic investigation of seed diseases is known to have been previously made. Therefore, it is desirable to consider this Bulletin as a preliminary study on the subject.

Acknowledgment is made to Professor J. B. S. Norton, of the Department of Plant Pathology, at the University of Maryland, under whose direction the work has been done and whose kindly criticisms and suggestions have been most appreciated. Director H. J. Patterson, of the Maryland Experiment Station, who made this investigation possible by placing the writer as a research assistant of the Department of Plant Pathology, deserves many thanks.

HISTORICAL REVIEW.

Introductory.

The first credible report of an internal seed infesting pathogen is that of Frank (38, 39),[1] who in 1883 found the anthracnose (*Colletotrichum lindemuthianum*) in beans in Germany. In 1885 Smith (83) reported the presence of telia of *Puccinia graminis* in the pericarp of oat kernels. Six years later, 1891, Halstead (47) discovered the anthracnose in beans in America. In the following year, 1892, Beach (5) stated that the bean blight (*Pseudomonas phaseoli*) may be carried within the seed. These earlier workers have marked the opening of the record of internal seed borne diseases. More detailed historical accounts regarding previous findings on the subject are to be presented under separate host plants in the following section.

Pathogens Found Within the Seed of the Host Plant.

Barley (*Hordeum vulgare*).

The loose smut (*Ustilago nuda*) and rust (*Puccinia glumarum*) have been recorded as internal seed borne diseases of barley. They are to be discussed later under "Wheat."

Beans (*Phaseolus spp.*).

The anthracnose disease (*Colletotrichum lindemuthianum*) was demonstrated to be internally seed borne by Frank (38, 39, 52) of Germany in 1883. In America, 1891, Halsted (47, 49) found the spores of the anthracnose in the cavity between the cotyledons, and believed that the disease can exist through the winter, or from one growing season to another in the mature beans. This was confirmed by Beach (5) in 1892. Whetzel (90) in his studies with bean diseases in 1906 stated that the seed-coat of unripe beans is easily penetrated by the mycelium

[1]The serial numbers in parentheses refer to "Literature cited," at the end of this Bulletin.

and the fungus is directly established within. A diagram showing the relation of the anthracnose to the tissues of the bean was also given (90, p. 204).

The bean blight (*Pseudomonas phaseoli*) was first noticed by Beach (5) in 1892, and he believed that it is possibly carried within the seed. In the same year Halsted (48) reported that the germs are carried over from season to season in the beans themselves. In 1906 Whetzel (90) noted that the bacteria can gain entrance into the seed and remain there dormant over the winter.

Clinton (23) in 1905 presented evidence of the lima bean mildew (*Phytophthora phaseoli*) being carried within the seed in the form of mature oospores and mycelium.

In 1917 Harter (51) reported that the podblight of lima beans (*Diaporthe phaseolorum*) invades the seed and inhibits its germination. He also stated that the organism is easily isolated from the seed.

Reddick and Stewart (78) in 1919 published an interesting account of the transmission of the virus of bean mosaic in seed. They obtained over 50 per cent. of mosaic plants from seeds which were diseased and sterilized externally in chloride of lime for four hours.

Beet (*Beta vulgaris*).

That the beet rust (*Uromyces betae*) causing decrease of sugar content of the root may remain latent in the seed during the winter in the form of an intracellular "mycoplasm" was reported by Eriksson (35) in 1914.

Bur Clover (*Medicago sp.*).

The bur clover leaf-spot (*Cercospora medicaginis*) was reported by Wolf (91) in 1916 to be carried as viable conidia on the burs. However, recent studies made by Hopkins (59) in 1920 have given evidence of the fungous mycelium in the seed coats. He obtained pure cultures of the fungus from seeds which had been treated in mercuric chloride 1:1000 for thirty seconds.

Cabbage (*Brassica oleracea*).

The black-leg disease (*Phoma lingam*) of cabbage has been reported as being carried within the seed in the form of dormant mycelium by Henderson (54) in 1918. He was able to isolate the organism from the seeds after "(*a*) removed from the pod under aseptic conditions, (*b*) exposures of 3, 5, 6 and 10 minutes, respectively, to a 1:1000 bichloride of mercury solution, and (*c*) immersion in a 1:200 solution of 40 per cent. formaldehyde for twenty-one minutes." He also concluded that "the fungus penetrates the seeds, causing them to shrivel and darken perceptibly."

Clover (*Trifolium pratense*).

Bondarstev (15) in 1914 reported that the blossom mold disease of red clover (*Botrytis anthophila*) has been found within the seed coats in the form of mycelium. In 1916 Jaczewski (62) stated that the mycelium of the blossom mold fungus penetrates the clover seeds, thus transmitting the disease from year to year and making the control difficult.

Corn (*Zea mays*).

Burrill and Barrett (20) in 1909 considered that the fusarium rot of corn is carried inside the grain. They detected the white mycelium of the fungus all through the diseased grains. In 1916 Pammel, King and Seal (74) reported that the mycelium of *Fusarium* occurs abundantly in the embryo and endosperm of the corn grain.

Burrill and Barrett (20) in 1909 also reported that the mycelium of *Diplodia zeae* (Schw.) Lev., which causes ear rot of corn, penetrates the young tissue of the grain.

That *Fusarium moniliforme* (82) may be carried within the seed as the cause of a serious root infection of corn plants in the field was reported by Valleau (87) in 1920.

Cotton (*Gossypium hirsutum*).

That the anthracnose disease (*Colletotrichum gossypii*) is carried in the seed was reported by Barre (2, 3) in 1912. He stated that the fungus remains in the interior of the seed as dormant mycelium and is able to live as long as 12 to 15 months. In 1913 Gilbert (45) published an account of his experiment made in 1905, in which he demonstrated that the fungus remained in the seeds and later killed the seedlings.

Rolfs (79) in 1915 noted that cotton seeds may harbor the organism of the angular leaf spot (*Bacterium malvacearum*) in the inner tissues and when planted transmit the disease to the young seedlings. However, in a recent study made by Faulwetter (37) in 1919, he concluded that the internal infection of the seed occurs very rarely.

Cucumber (*Cucumis sativus*).

In 1915 Eriksson (36) in Sweden suggested that the diseases of cucumber caused by *Cladosporium cucumerinum*, *Cercospora melonis* and *Colletotrichum lagenarium* are internally carried through the seeds, involving the "mycoplasm" stage.

Darnel (*Lolium temulentum*).

Guerin (46) in 1899 noted the constant presence of a fungus in the form of mycelium in the interior of the seed. In 1902 Freeman (40),

after performing a series of experiments, ascertained the presence of the fungus in the embryo of the darnel seed; and in 1904 he (41, 42) again noted internal infection by this fungus. No name was given to the fungus, as its spores were not found.

Evening Primrose (*Oenothera sp.*).

Galippe (44) in his studies with the parasites of seeds reported in 1915 that "*B. anthracoides*" is contantly present in the seeds of the evening primrose.

Flax (*Linum usitatissimum*).

The flax canker (*Colletotrichum lini*) was considered as a distinctly internal seed disease by Bolley (11) in 1910. Pethybridge and Lafferty (75) in 1918 reported that the fungus (*Colletotrichum linicolum*) causing the yellowing or damping-off of flax seedlings hibernates as mycelium in the epidermis of the seed coat. In the same year it was noted (1) in Ireland that a *Colletotrichum* causing a disease of flax seedlings hibernates in the skin of the seed and infects the plant while very young. The same fungus was probably referred to by different writers.

Grasses (*Gramineae*).

The occurrence of rust spores in the interior of seeds of grasses (*Bromus mollis* and *Agropyron spp.*) was noted by Beauverie (6) in 1913. He (7, 8) again in 1914 reported that the fruiting bodies of the rust within the seed coats of grasses aid greatly the dissemination of the epidemic. See also "Wheat."

Hollyhock (*Althea rosea*).

Eriksson (32) in 1911 reported that the rust of hollyhock (*Puccinia malvacearum*) may be carried in the seed. He (33) also stated, according to his "mycoplasm" theory, that the fungus passes the winter in symbiotic relations with the seed. In 1912 and 1914 Blaringhem (9, 10) of France made the same report, and thought the relation of symbiosis had become an acquired character of the host.

Oat (*Avena sativa*).

In 1885 Smith (83) found telia of *Puccinia graminis* in the pericarp of oat grain and also thought that teliospores are carried inside the aleurone layer of the grain.

Pea (*Pisum sativum*).

That the blight of peas (*Ascochyta pisi*) is an internally carried disease was first considered by Halsted (50) in 1893. Later in 1895

Krueger (63) noted the fungous mycelium growing out from pea seeds which had been soaked in water for 48 to 72 hours. Van Hook (88) in 1906 stated that the fungus grows through the husk of infected pods into the seed and produces spores there.

Dorothy Cayley (22) of England in her studies with a new bacterial disease of *Pisum sativum* reported in 1913 that the disease organism is transmitted in the interior of the seed.

Rice (*Oryza sativa*).

In 1918 Nishikado and Miyake (68) of Japan recorded the possibility of the brown spot disease (*Helminthosporium oryzae*) being carried within the rice grains.

Sweet Corn (*Zea saccharata*).

That the grains of sweet corn contain the germs of the wilt disease (*Pseudomonas stewartii*) was first reported by Stewart (85) in 1897. Later, Cook (24) in 1918 stated that the bacterial wilt carried in the seed from year to year is the chief means of dissemination.

Timothy (*Phleum pratense*).

That the leaf smut (*Ustilago striæformis*) may pass the winter in the embryo of the seed was demonstrated by Osner (73) in 1916. He noted that the smut enters the embryo of the seed, in the form of mycelium, through blossom inoculations.

Tomato (*Lycopersicum esculentum*).

Westerdijk (89) in her report on experiments with the tomato mosaic in Holland in 1910 has claimed that the disease is hereditary through the seed.

Wheat (*Triticum æstivum*).

In 1895 and 1896 Maddox (64, 65) of Tasmania noted the first evidence of internal seed infection in the loose smuts of wheat and barley (*Ustilago tritici* and *Ustilago nuda*, respectively). He stated that the ovaries of the wheat in the flowering stage can be artificially inoculated, and the grains developed from these infected ovaries produce smutted plants. Seven years later, 1903, Brefeld (18) observed the same occurrence. Hecke (53) in 1904 and Brefeld with his co-worker Falck (19) in 1905 have given a detailed account showing that the smut mycelium enters the ovary of the host plant and remains dormant in the mature grain. In 1907 Hori (60) reported the same result in his experiments in Japan. In America, Barrus (4) in 1908 and Freemen and Johnson (43) in 1909 published their conclusions in favor of previous in-

vestigators. Recently in 1918 Miura (67) of Japan has noted that the smut spores on the stigma of wheat and barley penetrate the tissue, and the fungus also was found in the embryo in the form of mycelium two or three days after the germination of its spores.

That the rust of grains may be transmitted within the seed through the dormant mycelium was the belief of Smith (84) in 1886. However, Eriksson (29) in 1897 advanced the mycoplasm theory for the transmission of the rust of wheat and barley (*Puccinia glumarum*). Zukal (92) in 1899 supported the dormant mycelium theory of Smith, and concluded that the mycelium lived over in the seed and grew into the embryo through the scutellum and developed with the plant. In the same year, Massee (66) developed the seed-borne spore theory. Later in 1914 Beauverie (7) found the spores of *Puccinia glumarum* within the seed coat of barley.

A conclusion was drawn by Eriksson (30) in 1898 that the common rust of wheat (*Puccinia graminis*) is inherited from the mother plant in the seed grain and lives there in a latent form which he called "mycoplasma." He (31) again in 1902 claimed that cereal rusts cannot be propagated either by an intercellular mycelium, or by groups of spores on the surface or in the interior of the grain. He further claimed that the uredo and teleutospores are not abundant enough to cause a habitual infection. However, in 1905 and 1906 Bolley and Pritchard (13,14) found both uredospores and teleutospores of the rust beneath the bran layer of the grain, and believed that the disease might be transmitted in this manner. Pritchard (76, 77) in 1911 presented evidence that the rust may be transmitted as dormant mycelium in the seed. In 1914 Eriksson (34), referring to an article by Beauverie (6) and the report by Pritchard (77), stated that he had reported the occurrence of rust spores in seeds of cereals in 1896, but that he considered it abnormal and not of practical importance in the propagation of the rusts.

Hungerford (61) in 1920, after a careful and extensive experiment, reported that the stem rust is not transmitted from one wheat crop to the next through the infected seed grain; although the uredinia and telia have been found embedded in the pericarp of wheat kernels.

The wheat scab (*Fusarium roseum*) was proved by Selby and Manns (81) in 1909 to be carried within the wheat kernel as an internal parasite.

In a study of the fungus flora of the straw and seed of wheat in 1913, Bolley (12) made the following statement: "They are *Alternaria, Macrosporium, Helminthosporium, Acrothecium, Colletotrichum, Fusarium* and *Cephalothecium*. Each of these can be obtained from the seed coats and interior of the grains from this section and from wheat samples from almost any wheat growing region in the world."

In 1915 O'Gara (72) reported a new disease of germinating wheat (*Podosporiella verticillata*) destroying the contents of wheat kernels at or near the time of germination. He also found the fungus producing no

growth external to the wheat kernel, being wholly within the epidermal covering.

Forms in Which Pathogens May Be Carried in the Seed.

The morphological structures or forms of the pathogens, in which they are carried within the seed, are highly important for the student of internal parasites of seeds to know. Based upon the pervious findings the following categories [1] have been made:

A. Sexual resting spores.
   1. Oospores of the *Phycomycetes*—for example, *Phytophthora phaseoli* of lima beans (23).
   2. Uredo and teleutospores of the *Uredinales*—for example, *Puccinia graminis* (13, 14).

B. Asexual bodies.
   1. Vegetative forms of bacteria—for example, *Pseudomonas stewartii* of sweet corn wilt (85).
   2. Vegetative mycelium of fungi—"The mycelium of a number of pathogenic fungi may invade the ovaries of the host without any marked or even evident injurious effect upon maturing seed. The intercellular mycelium in this condition suspends active growth during the dormant or resting period of the seed to resume active growth with the germination of the seed through the sprout of which it invades the growing plant." For example, *Colletotrichum lindemuthianum* of beans (90), *Phoma lingam* of cabbage (54), *Botrytis anthophila* of red clover (15), *Colletotrichum gossypii* of cotton (2,3), *Ustilago striaeformis* of timothy (73), *Ustilago tritici* (19, 60), *Ustilago nuda* (19, 60), and *Puccinia graminis* of wheat (76, 77).

C. "Mycoplasma"—According to Eriksson, a fungus may exist in the seed in a "mycoplasma" form which serves as the means of transmission from crop to crop. For example, *Puccinia graminis* of wheat (30), *Puccinia glumarum* of wheat and barley (30), and *Uromyces betæ* of beet (35).

D. Unknown form (physiological virus)—for example, bean mosaic (78) and tomato mosaic (89).

In regard to the question of how the parasites may be introduced into the seeds, Whetzel (90) has stated that unripe beans are easily penetrated by the anthracnose mycelium and the fungus is directly established within. Henderson (54) reported that the black-leg fungus is able to penetrate cabbage seeds, causing them to shrivel and darken. Van Hook (88) noted that *Ascochyta pisi* grows through the husk of infected pea pods into the seed. Galippe (44) in 1915 stated that parasites very likely gain entrance to the ovary with the pollen tubes. He

[1] In compiling these a section of "forms and conditions in which pathogens may be distributed," in the "reading outlines" of plant pathology, by H. H. Whetzel of Cornell University, has been freely consulted.

also reported that the wind not only carries the pollen grains but also other foreign particles collected on the way, alive or inanimate, and organic or mineral. He found the parasites in the anthers, on the pollen, in the interior of the style and ovary, and on the stigma. Therefore, he concluded that the parasites must have been introduced into the seed at the time of fecundation. The loose smut of wheat and barley is a good example (64, 65, 67).

PRESENT INVESTIGATIONS.

Materials.

The present investigations have been confined mainly to procuring some information regarding some fungi, whether saprophytic or parasitic, that are carried in the seed of agricultural plants. Seeds collected from both diseased plants and healthy plants, and seeds having diseased symptoms as well as seeds of normal appearance were used in the experiments. Pathogens isolated from these seeds, in which they may be harbored, have been carefully studied to determine their parasitism to the seedlings of host plants.

Development of Technique.

The technique for the study of internal seed diseases has never been standardized, for the methods are still in the experimental stage, and no extensive or systematic investigation of seed diseases has yet been made. However, a good general technique will be indispensably needed when such studies are made. In the present study, the development of the method is, therefore, emphasized with a view to paving the way for more practical results, as well as to serve as an easy means for attacking the problem of internal seed diseases. This method has been developed from the one used by Selby and Manns (81) in their studies on diseases of cereals and grasses. It seems desirable to give their own description of the technique employed by them, before taking up for consideration the writer's individual work. The details of their method follow:

"The grain is soaked in water 8 to 10 hours (preferably over night) to soften or germinate the spores most resistent to fungicides. The seed is then immersed for one to two minutes in alcohol (50 per cent.) containing two grams of corrosive sublimate in each 1000 cc. This solution is poured off and the seed covered with commercial alcohol, 93 per cent. (absolute alcohol is less liable to contain germinable spores) to remove traces of the fungicide; this latter operation is repeated. This treatment can best be carried out in flasks or tubes properly plugged. The surface sterile kernels can then be picked out with sterile forceps and placed on agar in Petri dishes; the latter should be placed in a moist chamber to aid the germination of the grain. Kernels which are found sterile upon germination may be removed by sterile forceps and placed in sterile soil or in sterile tubes for further study.

Cultures were made of wheat plants in tubes, of which the lower portion, one inch in length, was filled with absorbent cotton and moistened with tap

water. After being sterilized these served as an efficient means both of learning whether the kernels were infested with internal parasitic fungi and of the effect of these parasites in the seed upon the young plant."

The technique developed by the writer (70) and used in the experiment is outlined as follows:

1. Soak the seeds to be studied in water for 10 to 12 hours in room temperature. The presoaking is to render the spores of pathogens on the seed coats more susceptible to the action of the disinfectant, and at the same time to prevent seed injury by the disinfectant. The efficiency of this treatment has also been tested out by Braun (16, 17).

2. Shake the presoaked seeds from 2 to 5 minutes in an alcoholic solution of corrosive sublimate (2 grams to 1000 cc. of 50 per cent. alcohol) in a sterilized test tube.

3. Remove the traces of the disinfectant from the seeds by first washing once in ethyl alcohol (93 per cent). and then three times in sterile water.[1] The writer has determined by a series of experiments that the latter operation is absolutely necessary in order to prevent the alcohol from injuring the seeds. In the tests summarized in the following table, one hundred seeds of each kind presoaked in water for 10 hours were used for each trial. They were given the standard germination test in the State Seed Laboratory. The table shows the details and results.

Treatment.	Percentage of Germination.			
	Wheat.	*Corn.*	*Peas.*	*Soybeans.*
No treatment	72.5	88	92	92.5
Immersed in corrosive sublimate (alcoholic) solution for 5 minutes	0	74.5	58	89
Immersed in corrosive sublimate (alcoholic) solution for 5 min. and washed in 93% alcohol	0	20	11	53
Immersed in corrosive sublimate (alcoholic) solution for five minutes; then washed in 93% alcohol; then washed in water 3 times	60.5	91	77	90.5

The percentages in the table represent the average of two duplicate tests for each kind of seed.

[1]There is possibility of contamination in making several washings, but no evidence was found by the writer in his work.

Probably the alcohol washing could be eliminated, but it is desirable to remove any chance of interference with the growth of internal organisms.

PLATE I.

Shows the method of obtaining sterile seedlings by planting seeds externally sterilized in Petri dishes containing sterile, nutrient agar. Natural size.

4. Pick out the surface sterilized seeds with sterile forceps and plant them in sterile nutrient agar plates (Plate I) for germination, during which many of the pathogens carried internally will develop sufficiently to be recognized and can then be isolated for further examination.

Or, the surface sterilized seeds may be planted in large thick test tubes containing absorbent cotton saturated with a sterile nutrient solution (Plate II). Thus we are able to learn the presence of internally carried parasites of the seed, and to actually determine their effect upon the young plant. The nutrient solution enables the seedlings to continue their growth, so that death from lack of nutrient may not be

confused with the action of parasites. The cultures may be placed in a moist chamber to aid germination.

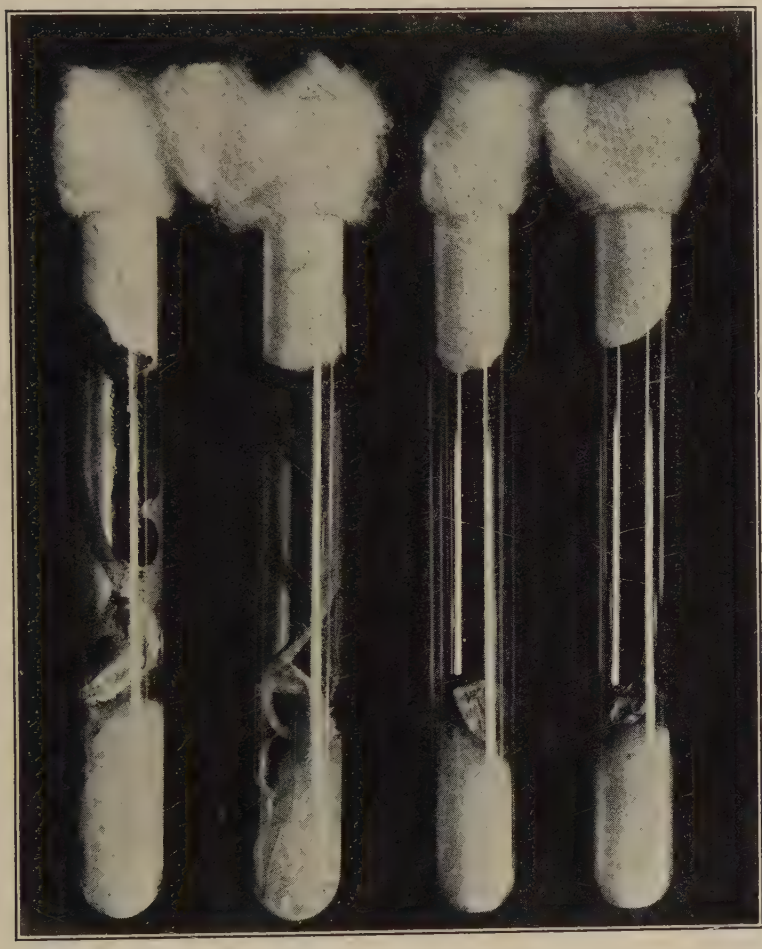

PLATE II.

Shows the method of germinating seed in sterilized test tubes containing absorbent cotton saturated with a sterile nutrient solution. Two-thirds natural size.

5. Pure cultures are made from the organisms developing from the infected seeds, and inoculation of the isolated organism into healthy plants both in tube cultures and in pot cultures in sand is also made.

Application of the Method.

1. Sampling the seeds—Representative samples were sorted out from the seeds collected. In each test an average of 25 to 35 seeds was used.

2. Sterilization of glassware—All petri dishes wrapped in paper, test tubes plugged with cotton and other glassware used in this investigation were sterilized in the hot air sterilizer for one hour at 150°C. All pots containing soils used in the experiments were first watered and then sterilized in a vertical autoclav (except when otherwise stated) for 3 hours at 120°C.

3. Preparation and sterilization of media[1]—The media used were nutrient agar and potato juice agar. The preparation and formula of each follows:

Nutrient agar—Prepared according to the following formula:

Agar	15 gms.
Sterile meat bouillon	900 cc.
Distilled water	300 cc.

The agar was cut into fine pieces and boiled in distilled water over a free flame until dissolved. The bouillon was then added to the agar and boiled for 20 minutes. It was allowed to cool to 45° to 50°C. and then the whites of three eggs were thoroughly mixed in. The mixture was heated over a water bath until the eggs were coagulated (30 min.). It was then filtered while hot through cotton or filter paper. The reaction was readjusted to +1.5, Fuller Scale.

Potato juice agar—Prepared according to the following formula:

Peeled potato	150 gms.
Agar	10 gms.
Distilled water	500 cc.

The potato was sliced into thin pieces and soaked in tepid water, allowing to simmer for half an hour. The juice obtained after filtering through cheese-cloth was used in place of bouillon. The remaining procedure was the same as the preparation of nutrient agar.

4. Preparation of cotton tubes—The cotton tubes were prepared by filling test tubes one inch with absorbent cotton which was saturated with a nutrient solution. Then the tubes were sterilized in an autoclav for one hour at 18 pounds pressure. The nutrient solution[2] used had an approximate osmotic pressure of 1.00 atmosphere and contained three salts in the following volume-molecular concentrations: Monobasic potassium phosphate (KH_2PO_4), .0022m; calcium nitrate ($Ca(NO_3)_2$), .0108m; and magnesium sulphate ($MgSO_4$), .0043m[3]. A trace of iron in the form of ferric phosphate ($FePO_4$) was added.

[1]The work was done in the laboratory of the Department of Bacteriology, and the writer wishes to acknowledge his indebtedness to Drs. E. M. Pickens and M. F. Welsh for their advice and co-operation during the preparation.

[2]The writer is indebted to Dr. Earl S. Johnston, Associate Plant Physiologist of this Experiment Station, for the preparation of this solution.

[3]The numbers indicate the fraction of the molecular weight of the salt in a liter of solution at about 20°C.

5. Germination of seeds and incubation of cultures—All the seeds and cultures were placed in a glass electric incubator for germination and incubation. Sometimes the germination of seeds, which were planted in the agar plates, was aided by placing them, in addition, in a moist chamber. The temperature of the incubator was varied between 20°-30°C., and recorded by a thermograph.

Presentation of Results.

Asparagus (*Asparagus officinalis*).

Cylindrophora sp. (Plate III, figs. 1 & 2)—Seeds of apparently normal appearance were collected from decayed berries and treated (according to the previously described technique) for 3 minutes. The seeds were then planted on November 15, 1919, in cotton tubes and agar plates. Seeds germinated after seven days. Six seedlings grown in cotton tubes were found to have a white fungous growth upon them. The fungus was identified as *Cylindrophora sp.* It did not appear to be parasitic to the seedlings.

Cabbage (*Brassica oleracea*).

No pathogens found—Sample 1 (large seed): Seeds of normal appearance were treated for periods of 2 and 3 minutes. All produced healthy seedlings three days after planting.

Alternaria sp. (Plate III, figs. 3 & 4)—Sample 2 (small seed): Seeds of normal appearance were subjected to the same treatment as sample 1. A species of *Alternaria* was found to inhibit the germination of seeds and to attack young seedlings which were grown in cotton tubes. The seedlings were wilted. During the experiment the writer was unable to note the presence of *Phoma lingam* which has been reported as being carried within the seed.

Common Bean (*Phaseolus vulgaris.*)

Species of *Fusarium, Macrosporium,* and *Alternaria* were isolated from a sample of seeds which had marked symptoms of disease. The details are well shown in the following table:

Length of Time in Treatment.	*Color of Fungous Colony.*	*Fungi Identified.*	*Germination.*	*% of Seed Infected.*
2 minutes.....	Whitish Pink	Fusarium	None	90
3 minutes.....	Gray	Macrosporium	None	95
5 minutes.....	Dark Gray	Alternaria	None	95

The seeds were treated according to the previously described technique. The fungi had grown out from the hilum of the bean. An undetermined species of bacteria, which gave a striking coral red colored pigment, was observed in all the cultures in tubes.

PLATE III.

Fig. 1.—**Cylindrophora sp.** isolated from surface sterilized asparagus seed; fertile hyphae with spores. Magnified.

Fig. 2.—Conidia of **Cylindrophora sp.** Magnified.

Fig. 3.—**Alternaria sp.** found in the seeds of cabbage; fertile hyphae with spores. Magnified.

Fig. 4.—Conidia of **Alternaria sp.** Magnified.

Cowpea (*Vigna sinensis*).

Macrosporium sp. (Plate IV,figs. 1 and 2)—Samples of seeds with diseased appearance obtained from the Department of Agronomy were

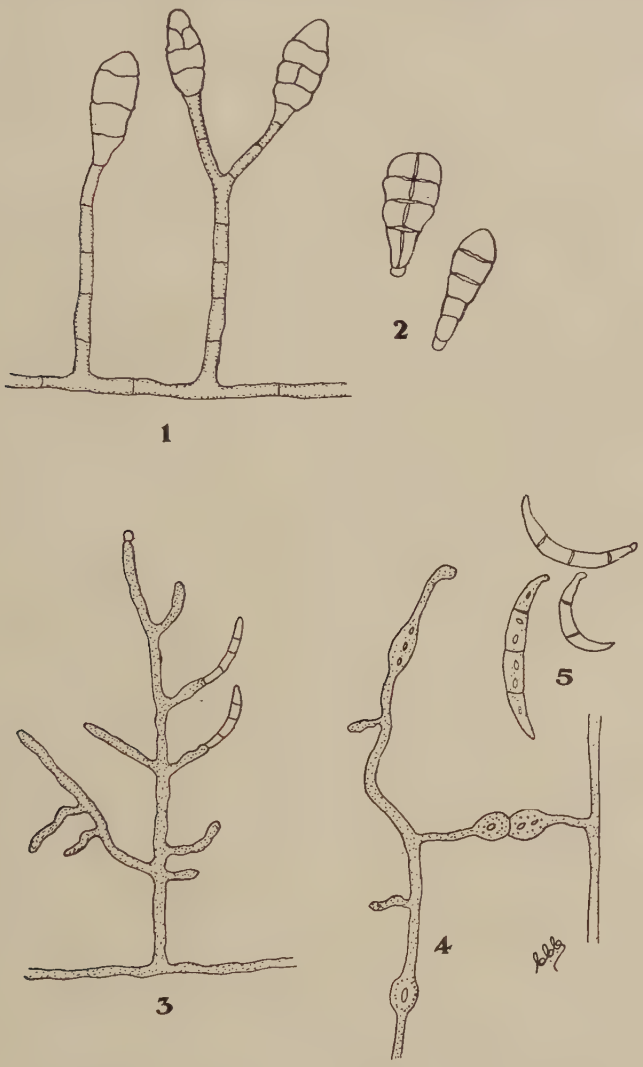

PLATE IV.

Fig. 1.—**Macrosporium sp.** isolated from surface sterilized cowpeas; fertile hyphae with spores. Magnified.

Fig. 2.—Conidia of **Macrosporium sp.** Magnified.

Fig. 3.—**Fusarium sp.** found in the seeds of Lima bean; fertile hyphae with spores.

Fig. 4.—Chlamydospores of **Fusarium sp.**

Fig. 5.—Conidia of **Fusarium sp.** Magnified.

treated for two different periods of 3 and 5 minutes. In one-half the cultures it was found that a dark gray fungus, *Macrosporium sp.*, had apparently prevented germination. Seedlings were obtained from the other half of the cultures, but all of them were also infected with the fungus. Apparently the fungus was not strictly parasitic to the host. However, the fungus gave the roots of seedlings a rusty appearance.

Lima Bean (*Phaseolus lunatus*).

Fusarium sp. (Plate IV, figs. 3, 4 & 5)—Seeds having much diseased symptoms were treated for 3 and 5 minutes and planted in cotton tubes and agar plates on November 12, 1919. A pinkish white mold growth had appeared on all the cultures one week later. None of the seeds germinated. The fungus was identified as a *Fusarium*. It had apparently grown out from the hilum of the seed.

Soybean (*Soja max*).

Macrosporium sp. and *Fusarium sp.*—These two fungi have been isolated from seeds having diseased symptoms. The pods were also covered with gray fungous spots. The experiment resulted thus:

Length of Time in Treatment.	*Color of Fungous Colony.*	*Fungi Found.*	*Germination.*	*% of Seed Infected.*
2 minutes.....	Black	Macrosporium	None	80
3 minutes.....	Black	Macrosporium	None	70
5 minutes.....	Pinkish	Fusarium	None	30

All plantings were made on April 26, 1920, and one week later it was noted that the fungi had grown out from inside the seed coat as tufts of mycelium.

Sweet Corn (*Zea saccharata*).

A fungous parasite of sweet corn seedling (Plate V, figs. 1 & 2)—While examining some harvested Stowell's Evergreen sweet corn ears in the Department of Vegetable and Floriculture early in January, 1920, it was noted that many kernels were infected with some kind of harmful organisms, giving a shriveled surface and discoloration of the grain.

A large number of diseased kernels were selected and taken to the laboratory. They were externally sterilized according to the previously described method for 3 minutes, and planted in agar plates and nutrient cotton tubes for germination under sterile conditions. One week later it was found that some kernels were infected with a white

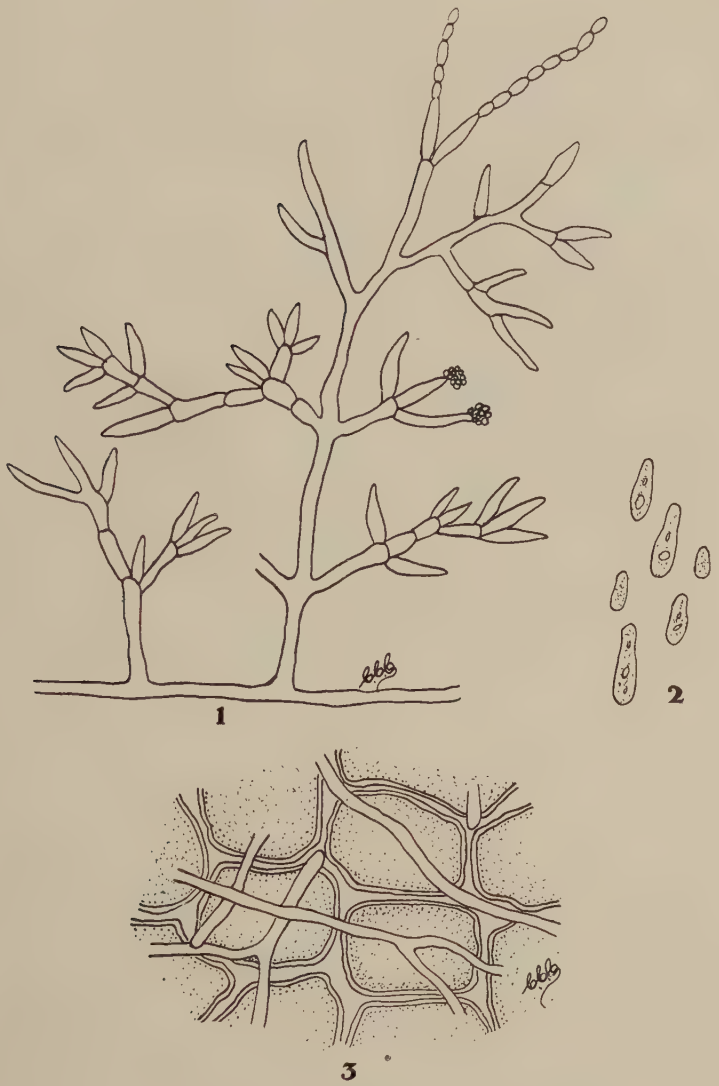

PLATE V.

Fig. 1.—A fungous parasite of sweet corn seedling; fertile hyphae with spores in chains and clusters. (Diagrammatic.)

Fig. 2.—Conidia of the fungus, Magnified.

Fig. 3.—Diagrammatic section showing the fungous mycelium in dead root tissue.

mold which had grown out from the inside of the kernels and apparently destroyed their contents, and some, although germinated, were also infected with the same fungus on their seedlings (Plate VI, fig. 1). The nutrient cotton tubes gave the best opportunity and facility to observe the fungous infection upon the growing seedlings (Plate VI, fig. 2). It was noted that the white fungus first begun to attack the tips of the roots, giving a brown discoloration, and gradually worked upward to the stem. The whole seedling was killed in about two weeks.

Pure cultures of the fungus were made on both nutrient agar and potato juice agar in tubes and plates. All of them served as good media for this fungous growth. On agar plates the erect fertile hyphae produced and the conidia formed on them can be clearly seen under a binocular. The formation of spores was observed within about 6 to 12 days. The fungus had the following characters:

Mycelium hyaline, elongated, branched; sterile hyphae creeping in the substratum; fertile hyphae erect, not branched, except for the short, often verticillate, side branches bearing the spores. Conidiophores straight, non-septate, hyaline, verticillate on lower part of fertile hyphae, alternate above, conidia in chains at the end of fertile hyphae and in clusters on the side of the fertile hyphae. Conidia oblong-ovoid, first in clusters and later in chains, hyaline, sometimes guttulate, 7.5-8.6-11.9 microns by 2.6-3.1-4 microns.

The fungus corresponds very well with the description of *Oospora verticillioides*, Saccardo, except that only the conidia in chains is mentioned by Saccardo (80). His description of the fungus follows:

"Caespitulis minutis albidis; hyphis sterilibus repentibus, ramulos fertiles simplices v. furcatos v. subverticillatos 70x3 continuos exserentibus; conidiis breiter catenulatis oblong-fusoidois v. subobclavatis, 8-10x2.5-3, hyalinis, quandoque guttulatis.

"Hab. in caryopsidibus maceratis Zeae Maydis, Padova et Conegliano Italiae borealis."

Oospora verticillioides was extensively studied by Tiraboschi (86) in an investigation of organisms in corn that might be connected with pellagra. Tiraboschi, like practically all other students of corn diseases, apparently overlooked similar work done in Russia in 1895 and 1896 by Deckenbach (25, 26), who in addition found that *Oospora verticillioides* was parasitic on corn. After Tiraboschi's paper was published, Deckenbach (27) again reviewed his original work in 1907.

It is probable that this fungus has been recorded under other generic names by some writers. *Cephalosporium sacchari*, described by Butler (21) as a sugar cane parasite in India, accords very well with this fungus, except that the conidia in chains were not noted by him. The distinctions between *Cephalosporium*, *Acrostalagmus*, *Verticillium* and similar genera are slight, and as the chains of spores of this fungus are not always easily found, this corn parasite may sometimes have been classed in one of these genera. During the study of this fungus the writer (71) was unable to note the presence of a *Fusarium* stage, but

1.

2.

PLATE VI.

Fig. 1.—Shows the internal fungous infection upon surface sterilized sweet corn grains grown in sterile nutrient agar plate.

Fig. 2.—Shows infection by the fungous parasite upon growing sweet corn seedlings in tubes.

if it should develop the parasite would have to be referred to *Fusarium moniliforme,* described by Sheldon (82) in 1903. This fungus was further reported by Valleau (87) in 1920 as the cause of the root infection of corn plants in the field.

To determine the pathogenicity of this fungus a series of inoculations was conducted. Healthy seedlings of both sweet corn and field corn grown in nutrient cotton tubes were inoculated with the fungus from the pure culture. They were all infected and killed in a time varying from 5 to 9 days. Thirty healthy plants of sweet corn were grown in the greenhouse in 6-inch pots (soils not sterilized; 3 plants in each pot) under conditions as nearly normal as possible. When the seedlings were 7-8 cm. high, inoculations were made as follows: 15 plants as control; 6 plants inoculated by pouring in around the root a spore suspension from a tube culture, and 9 plants inoculated by puncturing the stem just above the root with a sterile needle infected with a bit of fungous mycelium and spores from a pure culture. A similar inoculation test was made with field corn plants. The planting was started on April 19, inoculations made on May 3, and the experiment concluded on May 21. About 7 days after inoculation the plants with puncture inoculations had developed four cases in field corn and three cases in sweet corn, of distinct dwarfness and distortions. Such symptoms had been noticed in the field by Mr. T. H. White, in charge of Vegetable and Floriculture at the Station, who grew some sweet corn of the same variety last season. He has every reason to believe that this fungus was responsible for the barren stalks, root rot, and dwarfness occuring in the corn grown last season, but the writer was unfortunately not able to make a more extensive test in the field, owing to the limitation of time. The effect of inoculation on the height of the corn plants is shown in the following table:

Average in Height of Corn in Cm.

Kind.	*Control.*	*Inoculated with Spore Solution.*	*Inoculated by Puncturing.*
Sweet corn	52	47	42.8
Field corn	45.7	38	36.1

These striking results are shown further in Plate VII, figs. 1, 2 and 3.

In examining some of the distorted or stunted plants by cutting lengthwise through the base, the tissue seemed to have a marked brown discoloration. A section mounted under the microscope showed the presence of fungous mycelium in the cells of the decayed tissue (Plate V, fig. 3). The brown parts of the root of an infected plant were also externally sterilized and placed in agar plates for incubation. The same fungus was recovered from them.

In connection with this fungous parasite of sweet corn, it might be interesting to note the recent reports on the same subject by Hoffer and Holbert (55, 56, 58). They state that harmful organisms, such as species of *Gibberella, Fusarium, Verticillium, Rhizopus,* and *Pseudomonas,* although the technical description of them are not given, are responsible for missing hills, slow growing stalks, barren stalks, and rotting of the embryo. They (57) also thought that the common wheat scab organism, *Gibberella saubinetii,* is probably the most common pathogen responsible for the root and stalk rotting of corn plants. In addition, they recommend the ear-to-row method for studying the quality and value of seed ears, selection of seed ears from disease-free stalks, and the use of the germinating box for discarding seedlings from stock carrying disease-producing organisms as possible means of con-

PLATE VII.

Fig. 1.—Corn seedlings inoculated by puncturing the stem just above the root with a sterile needle infected with a bit of the mycelium of sweet corn seedling parasite. A case of distortion shown in one plant. Photographed 18 days after inoculation.

Fig. 2.—Control plants. Photographed at the same time as the inoculated plants.

Fig. 3.—Corn seedlings inoculated by pouring in the spore solution from the pure culture of the fungous parasite around the root system. Photographed 18 days after inoculation.

trol. Duddleston (28) of the Purdue Station more recently recommends the modified rag doll seed tester for controlling corn infecting organisms by a study of the germinating seedlings. These recommendations are worthy of consideration in developing methods of controlling the present fungous parasite.

Tomato (*Lycopersicum esculentum.*).

Mosaic—Seeds collected from mosaic diseased plants were planted in pots of sterilized soil on November 26, 1919, and 40 plants were secured from the seeds. Seeds from plants without mosaic were also planted as checks. The plants were placed in a greenhouse which was free from mosaic plants and insects. These plants were kept under observation until February 2, 1920, but they showed no mosaic symptoms. They were then inoculated by puncturing the stem with a needle infected with mosaic leaf tissue, and also by rubbing their leaves with crushed mosaic leaf. At that time the plants had developed their sixth leaves. Three weeks later they all showed the characteristic symptoms of mosaic, narrow, distorted and even filiform young leaves.

Rhizopus nigricans (Plate VIII, figs. 1 and 2)—That the seed from rotten tomatoes often has a dark color and may be injured by rot organisms had been reported by Norton and Leathers (69, p. 202) in 1918. They also stated that such seeds gave a poor germination. In the present experiment seeds from similar rotten tomatoes were used and divided into two parts for treatment (3 and 5 min.) according to the previously described technique. The treated seeds were planted in both cotton tubes and agar plates on November 14, 1919. Three weeks later the seedlings of 3-minutes treatment were found dead, and a gray colored mold had grown over them. The fungus was identified as *Rhizopus nigricans,* Ehr. To determine the pathogenicity of this fungus, ten inoculations were made on healthy seedlings grown in cotton tubes. In all cases the inoculated seedlings were killed 7 days later. Four inoculations were made on young plants (4th leaf developed) grown in pots in the greenhouse, but a negative result was obtained. No fungous infection was found on the seedlings of 5 minutes treatment.

Wheat (*Triticum aestivum*).

A sterile fungus (Plate VIII, fig. 3)—Shriveled wheat grains were treated for 3 minutes and planted in cotton tubes and agar plates. The seedlings grown in tubes were infected by a white fungus, which soon caused their death. A series of inoculations was made on healthy seedlings grown in tubes, and positive results were obtained. It was noted that the fungus first attacked the root system of the host and then gradually reached the stem. Pure cultures were made on nutrient agar, potato juice agar, and tomato stem. A vigorous growth of the fungus was noted on all of the media. The fungus was kept under observation over 5 months, but no conidia developed. The fungus in

colony was a felt-like white mass. Its mycelium was hyaline, non-septate, and much branched. Many large chlamydospores developed in the mycelium.

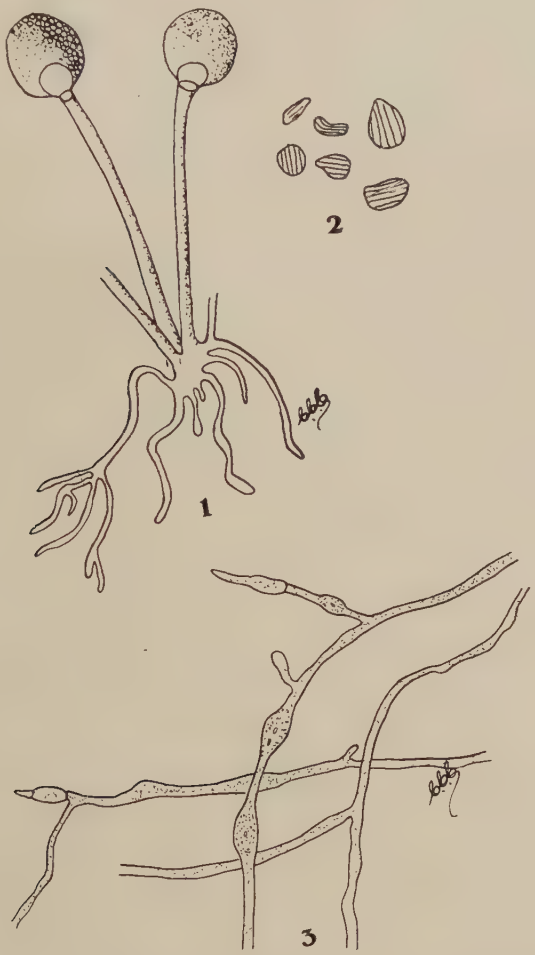

PLATE VIII.

Fig. 1.—**Rhizopus nigricans,** Ehr. isolated from dark seeds of rotten tomato; fertile hyphae with spores.

Fig. 2.—Conidia of **Rhizopus nigricans.** Magnified.

Fig. 3.—A sterile fungus isolated from wheat seedlings; mycelium with thick wall chlamydospores. Magnified.

Seeds Tested But No Pathogens Found.

Seeds of the following crops were tested, but no pathogens were found: Barley, alfalfa, timothy, red clover and crimson clover.

CONCLUSION AND DISCUSSION.

The literature cited in this paper and the experiments described show that some of the fungi and bacteria occurring in the seeds of host plants are pathogenic when, under favorable conditions, they come in contact with seedlings, while only a few forms apparently are non-parasitic. Their identity, as well as their pathogenicity to the host and the extent to which they affect crops should be ascertained by laboratory, greenhouse and field tests. These need to be reinforced by pure culture inoculations of seeds, seedlings and plants in various stages of growth under natural conditions before the exact relation of such internal parasites of seeds to the host can be definitely established.

This present paper has well demonstrated that the internal parasites of agricultural seeds have a direct bearing upon the production of crops. The subject is especially important when food production is imperative. Our most valuable foods consist of seeds, and healthy plants are developed from the sound seeds. With these points in view, there is an urgent need for a study of the parasites in seeds generally, as well as of their relation to crops. The present work is a preliminary survey of this question, but it is hoped that this preliminary work may be of value to farmers and investigators who are interested in the problems of healthy seed. It seems to the writer that if a more detailed and far-reaching study were made of this subject, it would be very promising in valuable additions to our knowledge of seed and seedling troubles.

The control of internal parasites of seeds is rather difficult. Ordinary seed treatment will not destroy these internal pathogens without destroying the vitality of the seed. However, seed selection from disease-free plants and planting seeds free from disease symptoms can be considered as practical means of control. Hot water and hot air are the most effective treatments for internal pathogens, providing the thermal death point of the pathogens is lower than that of the seed. A more critical study of the results of the germination test can be made to detect the primary infection upon seeds and seedlings by pathogens. Through further studies it will be possible to develop practical means to control internal parasites of agricultural seeds.

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ANNOTATED LIST OF HALTICINI

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Introduction.

During the warm days of summer, flea-beetles are usually very abundant and hundreds of them may be collected by sweeping over fields or pastures with an insect net. The tribe Halticini, or flea-beetles, consists of a group of beetles that are in most cases small and inconspicuous. With the possible exception of the leaf-hoppers (Jassidae) no other single group of insects will be found so prevalent in College Park. They are general feeders and usually occur in large numbers. Specimens of various species can be collected along the roadsides, in the fields, along the banks of small streams, on vegetables, fruits and field crops. Nearly every plant, useful or ornamental, that is grown in this locality has one or more enemies belonging to this interesting tribe. In many instances their life history is exceedingly complex. The annual financial loss resulting from the attacks of flea-beetles to plant life in general in the State of Maryland alone, approximates a million dollars. It has been said that they feed so voraciously on noxious weeds of various species that, in so far as weed control is concerned, flea-beetles are beneficial.

* The subject matter of the following pages was the basis for a thesis in part satisfaction of the requirements for the Bachelor's degree in entomology at the Maryland State College. The work was begun in 1911 and continued after Mr. Duckett entered the Bureau of Entomology, United States Department of Agriculture, in his spare time. Arrangements were made in 1918 for the publication of this manuscript, but many things delayed the project. On October 8, 1918, Mr. Duckett succumbed to an attack of influenza followed by pneumonia and the work is, therefore, published posthumously and any typographical or other errors should be attributed to the undersigned under whose direction the work was begun and finally brought to its present state. Mr. Duckett had planned to continue his work on the Halticini with the ultimate idea of monographing the group. In his original thesis, Mr. Duckett made the following acknowledgments: "Among those who have given me valuable assistance in the preparation of this list are, Dr. E. A. Schwarz and H. S. Barber of the National Museum, who gladly rendered valuable aid by verifying the determinations of many difficult species. The writer is likewise greatly indebted to Dr. F. H. Chittenden of the Bureau of Entomology for his valuable suggestions, and information which proved of great assistance." The keys are based upon the works of Blatchley, Horn and Crotch.

The original descriptions have been used in many instances; in others, the revised descriptions of Blatchley or Horn have been used verbatim or with slight changes.

The introduction and the arrangement of the text have been changed considerably from the form in which they were submitted in the thesis, principally for the purpose of condensation.

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GENERAL DESCRIPTION OF THE TRIBE HALTICINI.

The Halticini or flea-beetles constitute a tribe of the family Chrysomelidae, representing one of the twelve tribes into which this family has been divided. They are characterized by the structure of the posterior femora, which are more or less dilated, often greatly so, giving to the beetles the power of jumping, from which the older authors adopted the designation Saltatoriæ for the tribe. A striking character in a few genera is the abrupt inflation of the last joint of the hind tarsi. In these instances, the claws are usually smaller and more slender than on the anterior and middle legs, and in some species simple. On the contrary, however, they may be broadly appendiculate at the base. In the vast majority of our genera the claws are appendiculate. The claws are simple in the group Aphthonæ (Horn) with the exception of Blepharida in which they are bifid. The most important character for separating the genera is found in the open or closed structure of the anterior coxal cavities. Blatchley makes use of this important character to separate the entire series into two subtribes. As a rule the posterior tibia, at least, has a terminal spur, although several genera without this character are mentioned by Chapins. These genera, however, are not represented in our fauna. It is almost as rare to find genera with spurs on all the tibiæ as it is to find them with spurs on only one pair of tibiæ. A character of significance is found in the impressed lines at the base of the thorax.

Collectively the tribe is one which presents many complications and difficulties for study. The characters of taxonomic importance are few, and these are so often interlinked as to make it almost impossible to decide to which priority of importance should be given. To summarize, the Halticini comprises a very large tribe of small or medium sized beetles, oblong, oval in shape, and the majority of species possess a metallic lustre. Additional characters are: front coxae separated by a prolongation of the prosternum, and the third joint of the antennæ is, in most species, equal to or longer than the fourth. The tibiæ are frequently sulcate on the outer side and the tarsi retractile.

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LIST OF SPECIES FOUND IN COLLEGE PARK AND VICINITY.

GENUS—OEDIONYCHIS.

1. OE. gibbitarsa Say.
2. OE. vians Illig.
3. OE. vians var. scripticollis Say.
4. OE. thoracica Fabr.
5. OE. fimbriata Forst.
6. OE. limbalis Melsh.
7. OE. sexmaculata Illig.
8. OE. quercata Fabr.

GENUS—DISONYCHA.

9. D. pennsylvanica Illig.
10. D. quinquevittata Say.
11. D. caroliniana Fabr.
12. D. glabrata Fabr.
13. D. triangularis Say.
14. D. xanthomelæna Dalm.
15. D. mellicollis Say.
16. D. collata Fabr.

GENUS—LONGITARSUS.

17. L. subrufus Lec.
18. L. testaceus Melsh.
19. L. melanurus Melsh.

GENUS—GLYPTINA.

20. G. brunnea Horn.
21. G. spuria Lec.

GENUS—PHYLLOTRETA.

22. P. sinuata Steph.
23. P. vittata Fabr.
24. P. bipustulata Fabr.
25. P. picta Say.

GENUS—HALTICA.

26. H. rufa Illig.
27. H. chalybea Illig.
28. H. ignita Illig.
29. H. cuprascens Blatchley.
30. H. marevagans Horn.
31. H. fuscoænea Melsh.

GENUS—LUPERALTICA.

32. L. fuscula Lec.

GENUS—LACTICA.

33. L. tibialis Oliv.
34. L. iris Oliv.

GENUS—DIPHAULACA.

35. D. bicolorata Horn.

GENUS—SPHAERODERMA.

36. S. opima Lec.

GENUS—HYPOLAMPSIS.

37. H. pilosa Illig.

GENUS—PACHYONYCHUS.

38. P. paradoxus Melsh.

GENUS—BLEPHARIDA.

39. B. rhois Forst.

GENUS—CHAETOCNEMA.

40. C. subsylindrica Lec.
41. C. protensa Lec.
42. C. denticulata Illig.
43. C. minuta Melsh.
44. C. parcepunctata Crotch.
45. C. pulicaria Melsh.
46. C. confinis Crotch.

GENUS—CREPIDODERA.

47. C. rufipes Linn.
48. C. helxines Linn.
49. C. atriventris Melsh.

GENUS—ORTHALTICA.

50. O. copalina Fabr.

GENUS—EPITRIX

51. E. fuscula Crotch.
52. E. cucumeris Harris.
53. E. parvula Fabr.

GENUS—MANTURA.

54. M. floridana Crotch.

GENUS—SYSTENA.

55. S. hudsonias Forst.
56. S. frontalis Fabr.
57. S. elongata Fabr.
58. S. tæniata Say.
59. S. tæniata Say.
Var. blanda, Melsh.
60. S. marginalis Illig.

GENUS—DIBOLIA.

61. D. borealis Chevr.

GENUS—PSYLLIODES.

62. P. punctulata Melsh.
63. P. convexior Lec.

LIST OF SPECIES PROBABLY BELONGING TO THIS FAUNA BUT NOT COLLECTED BY THE AUTHOR.

GENUS—OEDIONYCHIS.

1. OE. petaurista Fabr.
2. OE. miniata Fabr.
3. OE. indigoptera Lec.

GENUS—DISONYCHA.

4. D. crenicollis Say.
5. D. abbreviata Melsh.

GENUS—LONGITARSUS.

6. L. turbatus Horn.
7. L. alternatus Zieg.
8. L. pygmæus Horn.

GENUS—APHTHONA.

9. A. insolita Melsh.

GENUS—PHYLLOTRETA.

10. P. armoraciæ Koch.

GENUS—HALTICA.

11. H. amœna Horn.

GENUS—CHAETOCNEMA.

12. C. crenulata Crotch.
13. C. quadricollis Schwarz.

SYNOPTIC TABLES.

(*Adapted from Blatchley*)

KEY TO SUBTRIBES OF HALTICINI.

a. Front coxal cavities open behind.....SUBTRIBE A.
aa. Front coxal cavities closed behind.....SUBTRIBE B.

KEY TO COLLEGE PARK GENERA, SUBTRIBE A. (*Halticini*)

a. Last joint of hind tarsi globosely swollen; punctures of elytra confused; surface glabrous; thorax very little narrower than elytra. **I. Œdionychis.**
aa. Last joint of hind tarsi not inflated, usually slender, sometimes thickened when viewed from the side.
b. Mesosternum always visible, usually moderately long.
c. Thorax without a transverse impression near the base; hind tibiæ faintly or not grooved.
d. First joint of hind tarsus short, as compared with the tibiæ, and rather broad; claws appendiculate; size medium, 4.5 or more mm. **II. Disonycha.**
dd. First joint of hind tarsus long and slender; claws simple; size smaller, less than 4 mm.
e. Hind tibiæ grooved above or on the outer edge, at least near apex; elytra without yellow stripes or spots.
f. Hind tibiæ with the apex entire, the spur placed in the middle in front of the tarsus.
g. Punctures of elytra confused; first joint of hind tarsus nearly or quite as long as half the tibiæ. **III. Longitarsus.**
gg. Punctures of elytra in regular rows; first joint of hind tarsus not more than one-third the length of the tibiæ and scarcely as long as the three following joints united. **IV. Glyptina.**
ff. Hind tibiæ deeply grooved above, with the apex notched or bilobed, the spur placed on the outer lobe; reddish-brown, shining. **V. Aphthona.**
ee. Hind tibiæ not grooved on the outer edge, slightly excavated near the tip, the spur at middle beneath; elytra each usually with a yellow stripe or spots. **VI. Phyllotreta.**
cc. Thorax with a transverse impression on basal half.
h. Transverse impression of thorax usually feeble, not distinctly limited at each end; elytral punctures, when present, confused.
i. Hind tibiæ each with a short terminal spur. **VII. Haltica.**
ii. Hind tibiæ wholly without spurs. **VIII. Luperaltica.**

hh. Transverse impression deep, limited at each end by longitudinal fold; above bicolored.

j. Elytra nearly smooth, the punctures, when present, extremely fine and scattered. **IX. Lactica.**

jj. Elytra with distinct punctures in rows.

k. Form oval; surface without erect hairs. **X. Diphaulaca.**

bb. Mesosternum very short, nearly concealed by the close approach of the pro- and metasterna; form orbicular or hemispherical; antennæ slender, but slightly thickened externally; color piceous black, shining. **XI. Sphæroderma.**

KEY TO COLLEGE PARK GENERA, Subtribe B. (*Chætocnemini*)

a. Last joint of hind tarsi globosely swollen; elytra with punctures in rows; hind tibiæ with one spur.

b. Thorax not impressed; body hairy; hind tibiæ with but one carina. **XII. Hypolampsis.**

bb. Thorax with a transverse impression near base; body glabrous; hind tibiæ with two carinæ on the outer side. **XIII. Pachyonychus.**

aa. Last joint of hind tarsi not inflated, usually slender, sometimes thickened when viewed from the side.

c. Antennæ 11- or 12-jointed; hind tarsi inserted at the end of the tibiæ.

d. Antennæ 12-jointed, distant at base; tarsal claws bifid; form robust, *Chrysomela*-like, larger, 5-6.5 mm. **XIV. Blepharida.**

dd. Antennæ 11-jointed, close together at base; claws simple or dilated; smaller, not over 4.5 mm.

e. Hind tibiæ sinuate near apex and with a distinct tooth on the outer margin; thorax without an impression in front of base; first and second ventral segments closely united; elytral punctures in regular rows. **XV. Chætocnema.**

ee. Hind tibiæ without sinuation or tooth.

f. Thorax with distinct transverse impression in front of base; elytral punctures in rows.

g. Elytra without hairs.

h. Form more or less ovate; antennæ shorter than body; transverse groove of thorax limited on each side by a lengthwise impression. **XVI. Crepidodera.**

hh. Form elongate, parallel; antennæ as long as or longer than body; thoracic groove not limited. **XVII. Orthaltica.**

gg. Elytra with rows of stiff hairs-(setæ) on the intervals; form short, ovate. **XVIII. Epitrix.**

ff. Thorax without a transverse impression in front of base.

i. Hind tibial spur small and slender; form elongate or elongate-oval.

j. Thorax with a short, deep longitudinal impression each side near base; elytral punctures in rows. **XIX. Mantura.**

jj. Thorax without any impression; elytral punctures confused. **XX. Systena.**

ii. Hind tibial spur broad, emarginate or bifid at apex; elytral punctures in rows; form oval or oblong-oval, convex. **XXI. Dibolia.**

cc. Antennæ 10-jointed; hind tarsi inserted on the outer side of the tibiæ above the apex; elytral punctures in rows. **XXII. Psylliodes.**

KEY TO THE COLLEGE PARK SPECIES.*

Subtribe A (*Halticini*).

I. Œdionychis Latr.

a. Antennæ stouter, scarcely half the length of body; species larger (4.5 or more mm.) and more convex; front of head oblique; elytral margins not flattened.

b. Elytra wholly of one color.

c. Elytra brilliant blue or green; thorax smooth; body beneath entirely pale. **1. Gibbitarsis.**

cc. Elytra dull blue or greenish-black; thorax more or less punctate; body beneath in great part dark.

d. Punctures of elytra distinct, often coarse and close; thorax bordered with pale. **2. Vians.**

Thorax reddish-yellow with an inverted W-shaped black spot. **3.** *var.* **Scripticollis.**

bb. Elytra bicolored, either with a pale margin or with stripes on the disk, rarely dull reddish-yellow, with the suture black.

e. Elytra bluish, the margin pale; thorax and elytra coarsely and closely punctate. **4. Thoracica.**

ee. Elytra dull yellow, with or without black stripes.

f. Elytra yellow with dark stripes.

g. Three stripes on each elytron: sutural, median and submarginal.

h. Form oblong-oval; front angles of thorax not dentiform; body beneath and legs pale. **5. Fimbriata.**

hh. Form oval; front angles of thorax dentiform; elytral dark stripes broad. **6. Petaurista.**

* Some species, though not collected by the author but recorded by others as belonging to this faunal area, are included.

gg. Two stripes on each elytron, sutural and median; oval or oblong-oval; fourth joint of antennæ distinctly longer than third. **7. Miniata.**

aa. Antennæ slender, as long as or longer than half the body; species smaller (usually less than 4.5 mm.), much depressed; front vertical; elytral margins usually flattened.

i. Elytra without explanate margin, the epipleuræ very narrow and vertical posteriorly. Elytra blue, head and thorax dull red, form oblong. **8. Indigoptera.**

ii. Elytral margins broadly flattened, the epipleuræ wide and horizontal.

j. Elytra broadly oval, sides much curved, coarsely punctate; dirty yellow with indistinct black lines. **9. Limbalis.**

jj. Elytra with sides feebly curved or nearly parallel, entirely piceous or yellow with piceous spots.

k. Thorax very coarsely punctured; elytra with a more or less evident costa from the humeri to apex. **10. Sexmaculata.**

kk. Thorax finely and sparsely punctured or smooth; elytra without costa on the side.

l. Head sparsely punctate or almost smooth.

m. Smaller, not over 4 mm.; elytra usually in great part piceous; umbone prominent. **11. Quercata.**

II. **Disonycha** Chevr.

a. Form elongate, parallel; elytra yellow with black stripes, subsulcate on the sides; thorax with an irregular impression each side. **12. Pennsylvanica.**

aa. Form more or less oval; elytra not subsulcate; thorax regularly convex.

b. Elytra with black and yellow stripes, or yellow with only a narrow sutural and submarginal black line.

c. Elytra with a submarginal black stripe.

d. Abdomen densely and finely punctured, subopaque and clothed with distinct pubescence.

e. Head coarsely punctured from side to side; occiput piceous or brown. **13. Quinquevittata.**

ee. Head smooth at middle.

f. Discal black stripes of elytra narrower than yellow; one each side; head and body beneath always pale yellow; labrum pale. **14. Caroliniana.**

ff. Discal black stripes of elytra as wide or wider than the yellow one each side; head and metasternum usually more or less fusceous or piceous; labrum piceous. **15. Crenicollis.**

dd. Abdomen very sparsely punctured and shining, its pubescence scarcely visible; thorax smooth; head rough; epipleuræ black. **16. Glabrata.**

cc. Elytra without a submarginal black stripe, the median stripe broad; thorax without spots. **17. Abbreviata.**

bb. Elytra without black and yellow stripes.

g. Elytra blackish-blue or green.

h. Body beneath and legs entirely black; thorax with three spots arranged in a triangle; elytra punctate. **18. Triangularis.**

hh. Body beneath and legs, in part at least, yellow.

i. Hind femora entirely or in part piceous; abdomen alone wholly yellow; elytra blue-black; head wholly piceous. **19. Xanthomelæna.**

ii. Hind femora entirely yellow; abdomen piceous, its apex and sides yellow; head bicolored.

j. Elytra blue or violet; body oval. **20. Mellicollis.**

jj. Elytra bright green; form more oblong. **21. Collata.**

III. **Longitarsus** Latr.

a. Antennæ with joints 2, 3 and 4 successively longer; inner wings always present.

b. Reddish-yellow, shining; thorax very plainly broader than long; punctation distinct. **22. Subrufus.**

bb. Brownish or piceous, with a faint bronzed lustre; punctures of elytra in vague rows. **23. Turbatus.**

aa. Antennæ with joints 2, 3 and 4 of equal length, or with the fourth not longer than second.

c. Surface more or less distinctly alutaceous; form rather elongate; humeri not prominent.

d. Color pale reddish-yellow; elytra not shining, the punctures very indistinct. **24. Testaceus.**

dd. Color dark reddish-yellow to piceous; elytra shining, the punctures coarse and well marked. **25. Melanurus.**

cc. Surface entirely shining; form robust, the humeri well marked and rather prominent; elytral punctation rather coarse in all species.

e. Color rufoferruginous; surface of thorax sparsely, finely and indistinctly punctate. **26. Alternatus.**

ee. Color brownish, or nearly piceous; thorax rather coarsely punctate.

f. Abdomen paler than the upper surface; posterior femora yellowish and not distinctly punctate. **27. Pygmæus.**

IV. **Glyptina** Lec.

a. Elytra yellowish or reddish-yellow.
b. Striæ on sides of elytra, especially the ninth, deeper than those of the disk; body beneath brown. **28. Brunnea.**
bb. Striæ on sides faint; body beneath brownish-piceous, very rarely pale. **29. Spuria.**

V. **Aphthona** Chevr.

(See description of species in Annotated List.) **30. Insolita.**

VI. **Phyllotreta** Chevr.

a. Fifth joint of antennæ longer than either the fourth or sixth; the male with the fifth joint always, and sometimes the fourth, thickened and elongate.
b. Elytra piceous, each with a yellowish stripe.
c. Elytral stripe narrower; lower angle of fifth joint not prolonged.
d. Stripes of elytra parallel with the suture on the basal half. **31. Sinuata.**
dd. Stripes of elytra incurved at base, approaching the scutellum. **32. Vittata.**
aa. Fifth joint of antennæ never longer than sixth; antennæ not different in the sexes, the joints gradually but slightly stouter from second to tip.
e. Elytra black and yellow.
f. Elytra each with two oval yellow spots, one on humerus, the other subapical. **33. Bipustulata.**
ff. Elytra dull yellow with a common sutural stripe and narrow marginal line, black. **34. Armoraciæ.**
ee. Elytra unicolorous.
g. Elytra bluish-green; metallic; head and thorax bright, reddish-yellow. **35. Picta.**

VII. **Haltica** Geoff.

a. Body above reddish-yellow, broadly oval; elytra smooth. **36. Rufa.**
aa. Body above blue, bronze, green or cupreous, more or less metallic.
b. Elytra without fold.
c. Antennæ and legs piceous, more or less metallic.

d. Thorax with a deep groove in front of base which extends completely across the thorax.

e. Larger species, 4-5.5 mm.; usually blue; form robust; thorax very distinctly wider at base. **37. Chalybea.**

ee. Smaller, 3-3.5 mm.; color distinctly metallic brassy green, blue or bronze; form more elongate; thorax scarcely wider at base. **38. Ignita.**

dd. Thorax with a moderate, sometimes obsolete, groove near base, which is never entire.

f. Humeral angles of elytra well marked, the umbone moderately prominent with a depression behind it; transverse impression of thorax deep at middle, evanescent on sides.

g. Thorax not visibly punctate, elytra relatively coarsely punctate; cupre-æneous. **39. Amœna.**

ff. Humeral angle of elytra rounded, the umbone feeble; transverse impression of thorax faint.

h. Color brilliant coppery red; larger, more robust, more broadly oval. **40. Cuprascens.**

hh. Blue; last ventral of male with a very deep impression extending half the length of segment; elytra finely, moderately punctate. **41. Marevagans.**

cc. Antennæ and legs in great part reddish-yellow, in striking contrast with the color of the upper surface.

i. Entire upper surface uniform in color and with metallic lustre.

j. Form oblong-oval, very convex; elytra scarcely alutaceous, the punctures distinct on basal half. **42. Fuscoænea.**

VIII. **Luperaltica** Crotch.

(See description of species in Annotated List.) **43. Fuscula.**

IX. **Lactica** Er.

a. Entirely lemon-yellow, tibiæ and tarsi black. **44. Tibialis.**

aa. Head and thorax yellow, elytra deep violet blue. **45. Iris.**

X. **Diphaulaca** Clark.

(See description of species in Annotated List.) **46. Bicolorata.**

XI. **Spæroderma** Steph.

(See description of species in Annotated List.) **47. Opima.**

SUBTRIBE B. (*Chætocnemini*)

XII. Hypolampsis Clark.

(See description of species in Annotated List.) **48. Pilosa.**

XIII. Pachyonychus Chevr.

(See description of species in Annotated List.) **49. Paradoxus.**

XIV. Blepharida Rogers.

(See description of species in Annotated List.) **50. Rhois.**

XV. Chætocnema Steph.

a. Sides of thorax regularly curved from base to apex, the front angles not obliquely truncated.
b. Head punctate, sometimes indistinctly so.
c. Rows of elytral punctures confused or irregular at base.
d. Punctures of elytral striæ 1 to 3 irregular near the base only; punctures of thorax coarse.
e. Form elongate, subcylindrical. **51. Subcylindrica.**
cc. Rows of elytral punctures regular.
f. Form elongate-oval, more than twice as long as wide; piceous, surface bronzed; apical portion of antennæ and all the femora piceous. **52. Protensa.**
ff. Form oval, not twice as long as wide.
g. Punctures of head distinct.
h. Punctures of the front and clypeus dense and rugulose; surface subopaque. **53. Denticulata.**
gg. Punctures of head small, indistinct.
i. Punctures of elytral striæ well impressed to apex; thorax with a distinct basal row of punctures. **54. Minuta.**
bb. Head absolutely without punctures.
j. Thorax with a basal marginal row of punctures.
k. Thorax shining, minutely alutaceous. **55. Parcepunctata.**
kk. Thorax subopaque, distinctly alutaceous. **56. Pulicaria.**
l. Thorax with coarse, moderately deep punctures, irregularly placed. **57. Crenulata.**
aa. Sides of thorax obliquely truncate at the front angles and with an angulation in front of middle; thorax without basal marginal line. **58. Confinis.**

m. Thorax without distinct basal marginal line.
mm. Thorax with distinct basal marginal line; antennæ and legs entirely yellow. **59. Quadricollis.**

XVI. **Crepidodera** Chevr.

a. Form oblong-oval or elongate.
b. Head and thorax yellow; elytra blue; thorax and prosternum smooth. **60. Rufipes.**
bb. Head and thorax of same color as elytra; thorax distinctly and rather coarsely punctured.
c. Elytra uniform in coloration; prosternum smooth or very sparingly punctate.
d. Form more oval; surface metallic blue, bronzed or green; thorax with fine and coarse punctures mixed. **61. Helxines.**
aa. Form broadly oval or ovate.
e. Reddish-yellow, without metallic lustre; thorax not distinctly punctured; abdomen piceous. **62. Atriventris.**

XVII. **Orthaltica** Crotch.

a. Antennæ stout in both sexes; elytral rows of punctures confused on each side of scutellum; ante-basal impression of thorax rather deep, but not sharply impressed; front punctate. **63. Copalina.**

XVIII. **Epitrix** Foud.

a. Upper surface piceous.
b. Thorax very densely and coarsely punctate; ante-basal impression very feeble. **64. Fuscula.**
bb. Thorax not densely punctate, the punctures well separated.
c. Ante-basal impression well marked.
d. Elytral striæ, especially those nearest the suture, very feeble, the punctures round, not crowded. **65. Cucumeris.**
aa. Upper surface reddish-brown; legs always pale.
e. Thorax rather closely punctate, the ante-basal impression scarcely visible. **66. Parvula.**

XIX. **Mantura** Steph.

(See description of species in Annotated List.) **67. Floridana.**

XX. **Systena** Chevr.

a. Elytra wholly piceous or dark brown, slightly bronzed.
b. Head entirely black. **68. Hudsonias.**

bb. Head dull reddish-yellow. **69. Frontalis.**

aa. Elytra dull yellow or with yellowish stripes.

c. Elytra piceous, with a yellow stripe reaching nearly to apex; genæ very coarsely punctate. **70. Elongata.**

cc. Elytra pale, dull yellow, sometimes with a paler median stripe; genæ smooth.

d. Surface shining, the punctation never very coarse; elytra each with a paler median stripe. **71. Tæniata.**

dd. Surface subopaque, the punctation coarse, close and deep; elytra without a paler median stripe. **72. Marginalis.**

XXI. Dibolia Chevr.

(See description of species in Annotated List.) **73. Borealis.**

XXII. Psylliodes Latr.

a. Elytral striæ feebly impressed, the punctures closely placed; last ventral segment of male distinctly impressed. **74. Punctulata.**

aa. Elytral striæ not impressed, the punctures well separated; last ventral of male convex, not impressed. **75. Convexior.**

ANNOTATED LIST OF HALTICINI (Subtribe A).

I. Œdionychis Latr., 1829.

A large genus of oval, small or medium-sized species having head inserted in the thorax to the eyes; thorax always much broader than long, deeply emarginate in front, the margin more or less dilated, base curved, usually obliquely sinuate near the hind angles; elytra oval, humeri not prominent; prosternum moderately wide between the front coxæ, the cavities open behind; side pieces of meta-thorax rather wide, parallel and roughly punctured; legs short and robust, front and middle tibiæ slightly broader at apex, the outer edge deeply grooved, hind femora very stout and thick, deeply grooved beneath for the tibiæ, which are short and feebly grooved; tarsi with first joint oblong, triangular, second smaller and narrower, last joint of hind pair globular; claws divaricate and dilated at base. Males with the first joint of front tarsus more broadly dilated and last ventral segment with a deep sinuation each side, the space between forming an oval lobe with a finely impressed line at middle.

1. Œdionychis gibbitarsa Say, Journ. Phil. Acad. Nat. Sci., IV, 1824, 83; ibid. II, 225.

Oval, slightly oblong, moderately convex. Head under surface and femora yellow or reddish-yellow; thorax yellow with four piceous spots, the two median ones often more or less confluent; elytra brilliant green or cobalt-blue; tibiæ, tarsi and antennæ piceous; scutellum black. Thorax more than twice as wide as long, margins moderately flattened, not translucent. Elytra sparsely and indistinctly punctulate. Length 5-7 mm.

One of our most beautiful species; very rare; not destructive. Several specimens were collected near College Park under railroad ties near a marsh.

Food plants: According to Blatchley, flowers of yarrow, wild hydrangea and other plants.

2. Œdionychis vians Illig., Mag. fur Insect., VI, 1807, 83.

Black, usually with a slight violet or greenish lustre; thorax reddish-yellow with an inverted W-shaped black spot (var. *scripticollis* Say) or with a large transverse discal spot, so that the margins only are pale; tip and sides of abdomen yellowish. Antennæ about half the length of body, third joint longer than fourth. Thorax twice as wide at base as long, narrowed in front, sides nearly straight, angles prominent; surface finely alutaceous, rather coarsely and sparsely punctate. Elytra a little wider at base than thorax, surface alutaceous, closely and finely punctate. Length 4.5-7 mm.

Occasionally collected under debris; not destructive and food plants unknown.

3. Œdionychis vians var. **scripticollis** Say, Journ. Phil. Acad. Nat. Sci., IV, 1824, 84; ibid. II, 226.

Form and general appearance of *vians*. The head has a transverse reddish spot between the eyes and another smaller one at the base of each antenna; thorax with the black discal spot in the shape of an inverted W. Elytral punctures distinctly coarser, deeper and more dense. Length 6-7 mm.

Very rare; two specimens determined as this variety were collected in a flood at Bladensburg.

4. Œdionychis thoracica Fabr., Syst. Eleut., I, 1801, 498.

Broadly ovate, feebly convex. Head, thorax and under surface reddish-yellow; thorax with seven black dots forming a curved front row and three just behind them, these often more or less confluent; elytra dark blue with a narrow margin on basal half and epipleuræ reddish-yellow; antennæ and tarsi piceous, the former half as long as body, third and fourth joints equal. Thorax slightly more than twice as wide as long, sides nearly straight, angles acute; disk rather coarsely and closely punctate. Elytra a little wider at base than thorax, surface rather coarsely and densely punctate. Length 5.5-7 mm.

Frequent, but not abundant. Collected by sweeping fields and meadow grass.

5. Œdionychis fimbriata Forst., Nov. Sp. Ins., I, 1771, 25.

Moderately convex, feebly shining. Dull reddish-yellow; thorax with five piceous spots, usually more or less confluent; elytra with only a narrow sutural line black, or with three piceous stripes, with intergrades; femora and under surface, except the metasternum, reddish-yellow; antennæ, tibiæ and tarsi piceous. Thorax more than twice as wide as long, feebly narrowed to front, margins narrow, surface finely alutaceous, rather coarsely and sparsely punctate. Elytra scarcely wider than thorax, surface closely punctate, more finely at apex. Length 5-7.5 mm.

Rare: Not of economic importance, varies somewhat in depth of coloration in individual specimens. Collected by sweeping banks of Paint Branch, College Park.

6. Œdionychis petaurista Fabr., Syst. Eleut. I, p. 495.

Oval, sometimes slightly oblong, convex, shining, above yellow, thorax with a variable central spot, elytra each with three black vittæ. Antennæ half as long as the body, piceous, the basal joints usually paler. Head reddish brown, cribrately punctate, a moderately deep longitudinal and feebler transverse groove, frontal carina short, tuberculiform, tubercles distinct, but flat. Thorax more than twice as wide as long, sides arcuately narrowing to the front, margin moderately wide, anterior angles dentiform, disk sparsely punctate, yellow, a central spot, piceous, of variable size and form; scutellum black. Elytra scarcely wider at base than the thorax, humeri rounded, surface always distinctly punctate, but variable in degree, color yellowish, with three piceous vittæ, sutural, median and submarginal. Epipleuræ testaceous, the inner edge at basal half piceous. Body beneath and legs reddish yellow, the anterior and middle tibiæ and tarsi brownish. Abdomen shining, very sparsely punctate. Length 5.5-8.5 mm.

Rare: A large variable southern species recorded from the District of Columbia by Ulke, but has not been collected in our fauna by the writer.

7. Œdionychis miniata Fabr., Syst. Eleut., I, 1801, 495.

Oval, slightly oblong, convex, feebly shining. Reddish-brown beneath, dull yellow above; thorax with a transverse brownish spot; elytra with a sutural and each with a median discal stripe blackish; antennæ, except the base, front and middle tibiæ, and all the tarsi piceous. Thorax three times as wide as long, sides curved and narrowed to the front; disk sparsely and finely punctate. Elytra variably, usually finely and rather closely punctate. Length 5-6.5 mm.

Listed in Ulke's List of Coleoptera of District of Columbia, but not found in College Park or vicinity.

8. Œdionychis indigoptera Lec., Proc. Amer. Phil. Soc., XVII, 1878, 416.

Oblong oval, subdepressed, reddish brown, feebly shining, elytra entirely blue. Antennæ slender, longer than half the body, rufescent, darker externally, third and fourth joints equal. Head sparsely punctate, a moderate interocular depression. Thorax not twice as wide as long, arcuately narrower to apex, margin moderately explanate, the front angle dentiform, surface distinctly alutaceous, sparsely, finely punctate. Elytra oval, slightly oblong, humeri obtuse, margin not explanate, umbone not prominent, disk moderately coarsely and closely, not deeply, punctate, surface alutaceous, entirely blue or bluish green. Epipleuræ piceous, narrow at apical half. Abdomen shining, sparsely punctate. Length 3-4 mm.

Extremely rare: A southern species which has been recorded as occurring in the District of Columbia, but has never been found by the writer.

9. Œdionychis limbalis Melsh., Proc. Phil. Acad. Nat. Sci., III, 1847, 162.

Broadly oval, subdepressed. Dull brownish-yellow; elytra each with four narrow fuscous or piceous lines or stripes as follows: one sutural, not reaching base, a second each side of scutellum, extending nearly to middle; a third slightly oblique, extending from umbone two-thirds to apex, and a fourth short one reaching from the umbone parallel with the side margin; these stripes may be one or all absent, or rarely all confluent into a large discal piceous space; head pale sparsely punctate. Antennæ longer than half the body, fuscous, the basal joints paler, third and fourth equal. Thorax nearly three times as wide as long, margins broadly flattened, front angles not dentiform, surface alutaceous, sparsely and obsoletely punctate. Elytra broadly oval, umbone moderately prominent; surface rather coarsely and closely punctate. Length 3.5-5 mm.

Similar to and listed by Henshaw as a variety of *quercata,* but, according to Blatchley, a distinct species. Frequent, collected in numbers on oak foliage.

10. Œdionychis sexmaculata Illig., Mag. fur Insect., VI, 1807, 104.

Depressed, subopaque. Above reddish or brownish-yellow marked with piceous as follows; spot on occiput, an indistinct irregular space on thorax, a broad common band behind the middle and three spots on each elytron, viz., one at

umbone, a second near the side margins and one between these near the suture, the latter set obliquely so as to form with its mate a V; middle of under surface piceous; antennæ and legs dull yellow. Thorax twice as wide as long, margins widely flattened; surface alutaceous, coarsely and sparsely punctate. Elytra a little wider at base than thorax; disk coarsely, deeply and rather closely punctate and with a distinct raised costa extending from umbone nearly to apex. Length 3-4 mm.

Common, but not destructive. Collected on oak and among debris in woods in College Park.

11. Œdionychis quercata Fabr., Syst. Eleut., I, 1801, 495.

Oval, depressed: Front of head, thorax, legs, epipleuræ and narrow margin of elytra yellow; disk of elytra and under surface piceous. Antennæ longer than half the body, outer joints piceous. Thorax more than twice as wide as long, margin widely flattened, front angles dentiform; surface finely alutaceous, very finely and sparsely punctate. Elytra not wider at base than thorax, umbone distinct, sulcate within; surface finely but distinctly and rather closely punctate. Length 3.5-4 mm.

Abundant: Slightly destructive to small oak trees.

Food plants: Oaks, red-haw, and probably several related species of trees.

II. Disonycha Chevr., 1834.

Oblong or oval beetles of medium size, having the head inserted as far as the eyes, front with distinct carina and two tubercles; antennæ slender, rarely longer than half the body, the fourth joint longer than third, except in the species with blue elytra, where the two joints are equal; thorax as wide at base as elytra, narrowed in front, sides obliquely sinuate, disk convex without transverse basal depression; elytra oblong or oval, the epipleuræ gradually narrower from base; front coxal cavities open behind; hind thighs much enlarged, grooved beneath; tibiæ more or less bisulcate on outer face, terminated by a moderate spur; first joint of hind tarsi as long as the next two; claws dilated at base. The males have the last ventral segment truncate, the pygidium vertical and convex; in the females the last ventral is oval and the pygidium horizontal.

The species feed upon herbs of various kinds and often do much damage to sugar beets and allied plants. They feign death when disturbed, falling to the ground, where they remain quiet for several minutes.

12. Disonycha pennsylvanica Illig., Mag. fur Insect., VI, 1807, 146.

Oblong, nearly parallel. Head black, front yellow; thorax pale yellow, usually with three black spots, the central one larger, truncate in front, gradually narrowed behind; elytra whitish-yellow with the suture, a submarginal stripe and a median stripe not reaching the apex, black; antennæ and under surface, except the prosternum and side of abdomen, black; femora reddish-yellow, tibiæ and tarsi usually black or piceous. Thorax more than twice as wide as

long, side margins rather wide, surface shining, nearly smooth. Elytra alutaceous, sparsely and finely but distinctly punctate, and in the female often feebly sulcate between the discal stripes. Length 6.5-7.5 mm.

Synonymy: var. *limbicollis* Lec.
var. *pennsylvanica* Illig.
uniguttata Say
vicina Kby.
procera Casey
var. *pallipes* Crotch
var. *conjugata* Fabr.

Frequent: Collected on grass and meadow mints by sweeping. One of our largest species in this fauna.

13. Disonycha quinquevittata Say, Journ. Phil. Acad. Nat. Sci., III, 1824, 85; ibid. II, 227.

Oblong-oval. Head yellow, occiput piceous; thorax yellow with normally five rounded black spots arranged in a front row of two and a hind one of three, often with only the two-spot row present; elytra yellow with a narrow sutural stripe, a submarginal line, often incomplete at base and not joining the sutural at apex, and a narrow median stripe (often wanting), black; antennæ piceous, the under side of the first three joints pale; under surface and legs reddish-yellow, the metasternum and tarsi piceous. Thorax twice as wide as long, front angles distinctly prominent, disk very finely and sparsely punctured and usually with a slight umbone on the outer dark spot. Elytra distinctly wider at base than thorax, surface finely and sparsely punctate. Length 6-9 mm.

Synonymy: *puncticollis* Lec.
fumata Lec.
pluriligata Lec.
punctigera Lec.
capitata Jacoby
var. *pura* Lec.

Scarce: Food plants: Willow, Catalpa buds, *Salix fluviatilis* trees, quaking asp. Larvæ often defoliate trees of *Salix fluviatilis* in the extreme south; not injurious in our fauna, but occasionally occurs in numbers on willow.

14. Disonycha caroliniana Fabr., Syst. Ent., 1775, 122.

Oval, slightly narrower in front. Head and thorax yellow, the latter with two piceous spots of variable size (rarely absent) on apical half; elytra yellow with a natural su-

tural stripe and a marginal line not covering the edge, black, these rarely united at apex; also with a median dark stripe narrower than the yellow spaces each side and not reaching apex; antennæ piceous, the under side of three basal joints pale; under surface and legs reddish-yellow, the tarsi and tips of tibiæ piceous. Thorax convex, more than twice as wide as long, sides feebly curved, margins narrow; surface smooth, polished or very indistinctly and sparsely punctured. Elytra scarcely wider at base than thorax, surface very finely alutaceous, finely and sparsely punctured. Length 5.5-6.5 mm.

Synonymy: *quinquevittata* Fabr.
alternata Illig.
pulchra Casey

Common in shore regions of Potomac River and Chesapeake Bay, but not very abundant in the vicinity of College Park.

Food plants: Cantaloupe, garden beets.

15. Disonycha crenicollis Say, Bost. Journ. Nat. Hist., I, 1835, 200; ibid. II, 668.

Very similar to *caroliniana*. Head with occiput usually in part piceous; thorax reddish-yellow with three piceous spots, arranged in a triangle, the front pair larger; elytra as in *caroliniana*, the median black stripe as wide or wider than the yellow one each side, the sutural and marginal ones joining at tip. Thorax not more than twice as wide as long, its surface, as well as that of elytra, more distinctly alutaceous and more evidently punctate than in *caroliniana*. Length 5-6 mm.

Listed by Ulke from District of Columbia and undoubtedly occurs in College Park, but was never collected by the writer.

16. Disonycha glabrata Fabr., Spec. Ins., I, 1781, 156.

Oblong-oval, surface very shining, as if varnished. Head often entirely black except the front, sometimes nearly wholly yellow; thorax yellow, usually with a narrow median spot, sometimes an indistinct spot each side; elytra yellow, the suture, margins and a median stripe black; under surface and legs usually yellow, tips of tibiæ and tarsi, and sometimes the hind portion of metasternum, piceous. Thorax more than twice as wide as long, margins narrow, surface smooth, shining. Elytra a little wider at base than thorax, very finely and sparsely punctate. Length 5-5.5 mm.

Common everywhere in the vicinity of College Park. Very abundant on both of our species of pigweed, *Amaranthus retroflexus* and *A. spinosus*.

Food plants: *Amaranthus retroflexus, A. spinosus,* sugar beet, and beans.

17. Disonycha abbreviata Melsh., Proc. Phil. Acad. Nat. Sci., III, 1847, 163.

Oval, slightly oblong. Head, thorax, scutellum, under surface and femora, reddish-yellow; elytra paler yellow with a sutural stripe and a median one on each, both rather wide, black; antennæ piceous, the two basal joints and the apical one paler; tibiæ and tarsi yellow, with a black line on outer side. Thorax nearly twice as wide as long, narrowed in front, sides curved, margins narrow, surface smooth. Elytra slightly wider at base than thorax, umbone distinct, surface finely alutaceous, very finely and sparsely punctate. Length 6-8.5 mm.

Scarce: Listed by Ulke from District of Columbia, but was not collected by the writer in the vicinity of College Park.

18. Disonycha triangularis Say, Journ. Phil. Acad. Nat. Sci., IV, 1824, 84; ibid. II, 226.

Oval, rather depressed. Black; thorax above and beneath yellow, with the front pair of spots round, the hind one linear; elytra with a faint bluish tinge; antennæ piceous, the three basal joints pale beneath. Thorax more than twice as wide as long, sides feebly curved, margins very narrow, surface alutaceous, rather finely, not closely punctate. Elytra a little wider at base than thorax, surface rather closely but distinctly punctate. Length 5-6.5 mm.

Synonymy: *puncticollis* Kby.

Scarce: Not listed by Ulke from District of Columbia; never destructive in our fauna.

Food plants: Sugar beets, *Amaranthus* spp., spinach, and *Chenopodium.*

19. Disonycha xanthomelæna Dalm., Analecta Ent., 1823, 79.

Resembles the preceding but usually smaller and more oblong. Thorax entirely yellow; elytra black with faint greenish tinge; abdomen wholly yellow, meso- and metasterna black; femora usually yellow on basal half, sometimes wholly black; tibiæ and tarsi piceous. Thorax not twice as wide as long, surface almost smooth. Elytra wider at base than thorax, surface finely alutaceous, obsoletely and very finely punctate. Length 4.5-5.5 mm.

Synonymy: *collaris* Fabr.

Food plants: Garden beets, sugar beets, spinach, Swiss chard, Chenopodium, *Stellaria media,* and bunch beans.

Very common and destructive. Commonly known as the "spinach flea-beetle" by virtue of its destructiveness to spinach plants. This is

one of the most abundant and injurious species of the tribe in this fauna. It is also the first flea-beetle to appear in abundance in the early spring.

20. Disonycha mellicollis Say, Bost. Journ. Nat. Hist., I, 1835, 199; ibid. II, 668.

Resembles closely the preceding. Differs by having the head blue-black and coarsely punctured between the eyes, the front yellow; femora entirely yellow; abdomen piceous at middle, with the apical segment and wide side margins yellowish. The elytra are sometimes nearly black, more often with a distinct bluish tinge. Length 4.5-5 mm.

Synonymy: *semicarbonata* Lec.

Food plants: *Stellaria media, beets,* Portulaca, spinach, Amaranthus, Alternanthera, sugar beets, *Helianthus tuberosus* L., turnip, Swiss chard.

Appears periodically at College Park in numbers, but never seriously injurious in this fauna. Collected by the writer eating chickweed under boards placed as fleabeetle traps in fields. Not recorded from the District of Columbia by Ulke.

21. Disonycha collata Fabr., Syst. Eleut., I, 1801, 463.

Subdepressed. Vertex and occiput black with faint greenish tinge, front yellow; thorax yellow above and beneath, without spots; elytra blue-green, shining; metasternum black; abdomen piceous, the last segment and the sides broadly yellowish; femora pale yellow, tibiæ at tips and tarsi piceous. Thorax and elytra very finely alutaceous, the former minutely and sparsely punctate; the latter with fine, distinct, sparsely placed punctures. Length 4-4.5 mm.

Frequent: Many specimens were captured by sweeping. Closely resembles the preceding species. Not destructive, or of economic importance.

III. Longitarsus Latr., 1829.

This and the three succeeding genera belong to a group, *Aphthonæ* of the *Halticini*, having the form oval; antennæ 11-jointed; front coxal cavities open behind; thorax without trace of basal impressions; hind tibiæ grooved, at least near the apex, and terminated by a rather long spur; hind tarsi with last joint not inflated, the claws simple. The members of the genus *Longitarsus* are very small oval or oblong convex species, usually uniform dull yellow, brownish or piceous in hue, with the elytral punctures much confused; tarsi slender, the first joint of the hind pair nearly or fully half the length of tibiæ and as long as all the following joints united.

22. Longitarsus subrufus Lec., Col. Kan., 1859, 26.

Convex. Reddish-yellow, shining; antennæ and legs pale reddish-yellow, the outer five joints of former and hind femora slightly darker. Thorax one-third wider than long, not

narrowed in front; disk convex, shining, very sparsely and finely punctate. Elytra wider at base than thorax, umbone rather prominent; disk convex, punctures rather fine, not closely placed. Length 2.5-3 mm.

Scarce: Listed by Blatchley from Indiana, feeding on the stems and leaves of the false gromwell, *Onosmodium carolinianum* DC. The largest species of the genus found in this fauna.

23. Longitarsus turbatus Horn, Trans. Amer. Ent. Soc., XVI, 1889, 279.

Subconvex. Piceous or chestnut-brown, feebly bronzed; antennæ piceous, the four basal joints pale; front and middle legs and hind tibiæ yellowish; hind femora brown. Thorax nearly one-half wider than long, slightly narrowed in front, sides feebly curved, surface smooth or nearly so; basal marginal line wanting. Elytra wider at base than thorax, umbone distinct, punctures rather coarse and close. Length 2.5 mm.

Similar to the preceding species. Listed by Ulke from the District of Columbia, but not collected by the writer in the vicinity of College Park.

24. Longitarsus testaceus Melsh., Proc. Phil. Acad. Nat. Sci., III, 1847, 166.

Moderately convex. Dull brownish-yellow, surface finely alutaceous and with a greasy aspect; antennæ and legs pale brownish-yellow. Thorax one-third wider than long, not narrowed in front; disk moderately convex, very distinctly alutaceous, finely, sparsely and indistinctly punctate. Elytra very little wider at base than thorax, umbone distinct, not prominent; surface finely and sparsely punctate. Length 2 mm.

Frequent: Collected by sweeping roadside herbage, and also found hibernating under boards in early spring. Not an injurious species.

25. Longitarsus melanurus Melsh., Proc. Phil. Acad. Nat. Sci., III, 1847, 166.

Moderately convex. Dark reddish-brown to piceous, alutaceous, shining; antennæ reddish-brown, apical half darker; front and middle legs dull yellow, hind femora brown. Thorax slightly wider than long, not narrowed in front, sides feebly curved; disk convex, slightly wrinkled near base, sparsely and rather coarsely punctured. Elytra evidently wider at base than thorax, umbone distinct, the punctures coarse, deep and rather close. Length 2-2.5 mm.

Scarce: Only two specimens collected and these were clinging to a stick in a flood at Bladensburg.

26. Longitarsus alternatus Zieg., Proc. Phil. Acad. Nat. Sci., II, 1846, 271.

Moderately convex. Dark brick-red, shining. Antennæ three-fourths the length of body, piceous, the four basal joints paler. Thorax one-third wider than long, sides curved; disk convex, nearly smooth except along the base, where there are a few fine punctures. Elytra wider at base than thorax, umbone feeble; punctures coarse, much confused, finer near the sides. Length 2.5 mm.

Exceedingly rare: Listed by Ulke from the District of Columbia, but has never been found anywhere in Maryland by the writer.

27. Longitarsus pygmaeus Horn, Trans. Amer. Ent. Soc., XVI, 1829, 284.

Oval, robust, convex, piceous, shining. Antennæ slender, brown, three basal joints paler. Head impunctate, feebly shining. Thorax one-half wider than long, not narrowed in front, sides feebly arcuate, vaguely subangulate at middle, anterior angles truncate, disk moderately convex and shining, the punctation moderately coarse and deep, closely placed at base, sparser in front. Elytra very obviously wider at base than the thorax, humeri obtuse, umbone moderately prominent, form regularly oval, widest at middle, scarcely more than a fourth longer than wide, sutural angle well defined, disk convex, punctation coarse, deep and closely placed, subtriately arranged at base, less deep at apex. Body beneath paler than above. Abdomen very indistinctly punctate. Legs entirely yellowish testaceous, the posterior femora not distinctly punctate. Length 0.06 inch; 1.5 mm.

Rare: A very small southern species, reported by Ulke as occurring in the District of Columbia. The writer has failed to find a single specimen in the vicinity of College Park.

IV. Glyptina Lec., 1859.

Small oblong or oval, dull yellow or blue and yellow species resembling *Longitarsus* in general appearance, but having the elytral punctures in distinct rows on base and sides, often confused at tip; the first joint of hind tarsi not more than one-third the length of tibiæ; antennæ slender, as long as half the body, first joint cylindrical, second conical, more than half the length of first, joints 3 to 7 gradually increasing in length, 8 to 10 shorter, 11th longer and acute at tip; tarsal claws simple.

28. Glyptina brunnea Horn, Trans. Amer. Ent. Soc., XVI, 1889, 291.

Oblong oval, rather robust, moderately convex, shining, reddish brown above and beneath, legs and antennæ pale rufotestaceous. Head smooth, impunctate. Thorax nearly twice as wide as long, slightly narrowed in front, anterior angles obliquely truncate, with slight post-apical angulation, sides feebly arcuate, disk convex, shining, the punctures extremely fine and sparse. Elytra very distinctly wider than the thorax, humeri obtuse, umbone moderately

prominent, disk striato-punctate, the punctures moderately coarse and closely placed, but not serrate, the ninth stria more distinctly impressed than the discal, intervals flat, wider than the striæ, uniseriately finely punctate. Body beneath a little darker than above. Abdomen slightly rugulose and punctate, the last two segments more closely. Length 0.07-0.08 inch; 1.75-2 mm.

Rare: Three specimens collected by beating and sweeping in a pasture near Bladensburg.

29. Glyptina spuria Lec., Col., Kans., 1859, 26.

Oblong-oval, moderately convex. Above pale brownish-yellow, shining; beneath piceous; antennæ reddish-yellow, outer joints darker; legs pale. Thorax one-half wider than long, not narrower in front, sides obliquely truncate near front angles and angulate in front of middle; disk rather coarsely and sparsely punctate. Elytra distinctly wider at base than thorax, feebly striate, the striæ coarsely and closely punctate; intervals wider than striæ, slightly convex, each with a row of minute punctures. Length 1.5-1.7 mm.

Exceedingly rare: One specimen collected at a flood near College Park.

V. Aphthona Chevr.,1834.

Very small, oblong-oval, reddish-brown species, having the antennæ rather stout, longer than half the body, third joint more slender and a little longer than second, 4 to 7 gradually longer, 8 to 10 slightly shorter, 11th suddenly constricted and acute at tip; hind tibiæ grooved above, notched or bilobed spur on outer lobe.

30. Aphthona insolita Melsh., Proc. Phil. Acad. Nat. Sci., III, 1847, 168.

The elytra nearly quadrate, convex. Brownish-red, strongly shining; sixth to ninth joints of antennæ fuscous, the others dull yellow. Thorax one-fourth wider than long, not narrowed in front, front angles obliquely truncate, sides nearly straight, with distinct angulation in front of middle; disk smooth and polished. Elytra distinctly wider at base than thorax, humeri and umbones prominent, surface with faint rows of very minute punctures. Length 2 mm.

Exceedingly rare: Listed by Ulke as occurring in the District of Columbia, but has never been found in our fauna by the writer. Blatchley lists this species from Indiana and records it beaten from Indian currant, *Symphoricarpus vulgaris* Michx.

VI. Phyllotreta Chevr., 1834.

Small elongate-oval or oblong-oval subconvex species, separated from allied genera by characters pertaining to the hind tibiæ as mentioned in the generic key. They have the head small, deeply inserted in the thorax, antennæ half as long as body, or slightly longer;

thorax broader than long and somewhat narrowed in front; elytra oval, the humeri never prominent, usually marked with a yellowish white sinuous stripe; first joint of hind tarsus about one-third the length of tibiæ and equal to the other three; claws simple. The males have the last ventral more or less impressed at tip. All feed upon cruciferous plants, both cultivated and wild.

This genus comprises many of our most injurious species.

31. Phyllotreta sinuata Steph., Illust. Brit. Entom., IV, 297.

Elongate-oval, subconvex. Piceous, shining; elytra each with a narrow, dull yellow stripe, parallel with the suture at base, and with a short, broad branch behind the humerus, the apical third strongly sinuate; antennæ piceous, the three or four basal joints paler. Thorax nearly twice as wide at base as long, distinctly narrowed in front; disk convex, surface finely alutaceous, rather coarsely and sparsely punctate. Elytra slightly wider than thorax with the punctures coarser and more close-set than on the latter. Length 2.5 mm. Last ventral of male slightly sinuous each side with a broad triangular impression at apex and joints 2-3-4 of antennæ nearly equal in length, the fourth much broader, fifth longer than the preceding two and much dilated, sixth short, oval, narrow at base, 7-10 equal in length, eleventh longer. Last ventral of female simple and antennæ same as in *vittata*.

Very common and destructive. A very common species in Europe and introduced into this country. Often in company with *vittata*.

Food plants: Hickory, turnip, radish, mustard, pepper and many other cruciferous plants.

32. Phyllotreta vittata Fabr., Syst. Eleut., I, 1801, 469.

Smaller than *sinuata* and with the yellow stripe of elytra narrow at middle, incurved at base, broader and slightly incurved at tip; legs piceous, tibiæ and tarsi brownish-yellow. In the males the fourth joint of antennæ is broader than the third, fifth a little broader and nearly equal in length to third, whereas in *sinuata* the fourth is much broader than the third, and the fifth longer than the two preceding together and much dilated. Length 2 mm.

Synonymy: *striolata* Fabr.

Exceedingly abundant at times. One of our most injurious species.

Food plants: Cabbage, turnip, radish, mustard, shepherd's purse, *Capsella* sp., pepper grass, *Lepidium virginicum* L., rape, cauliflower, Brussels sprouts, gallberry, *Ilex glabra*, sugar and garden beet. Often accompanied with *bipustulata, sinuata* and *Psylloides punctulata*. The parasite *Perilitus schwarzi* is often reared from adults. Occasionally feeds on young strawberry plants.

33. Phyllotreta bipustulata Fabr., Syst. Eleut., I, 1801, 464.

Rather robust. Piceous without metallic lustre; elytra each with a large oval humeral spot, touching base but not including the umbone, and a subapical more elongate and narrower spot, yellow; antennæ piceous, the basal five joints paler; legs reddish-yellow, the hind femora darker beneath. Thorax one-third wider than long; disk finely alutaceous, rather finely and sparsely punctate. Elytra distinctly wider at base than thorax and with coarser punctures. Length 2-2.5 mm.

Frequent and destructive.

Food plants: Turnip, mustard, radish, cabbage, other cruciferous plants and occasionally rose.

Often feeds on the under side of leaf and therefore may escape notice. Found quite often in company with *sinuata* and *vittata*.

34. Phyllotreta armoraciæ Koch, Ent. Heft., II, 1803, 75.

Elongate-oval, convex. Head, thorax and under surface black, shining; elytra dull yellow, with a common sutural stripe and very narrow side and apical margins, black; antennæ and femora piceous, the basal three joints of former and tibiæ and tarsi dull brownish-yellow. Thorax one-third wider than long, sides curved and rounded to apex; surface finely and sparsely, that of elytra more coarsely and densely punctate. Length 3-3.5 mm.

Food plant: Horse-radish.

An European species recently introduced into the United States. Not listed by Horn or Ulke, but included in Blatchley's catalogue from Indiana. This species has not been collected in College Park or vicinity, but the writer believes it will be definitely located in our fauna before many years, so deems it best to include it in this list. It has been recorded frequently from New Jersey feeding on horse-radish.

35. Phyllotreta picta Say, Journ. Phil. Acad. Nat. Sci., IV, 1824, 87; ibid. II, 228.

Oval, slightly oblong, feebly convex. Head and thorax pale reddish-yellow; elytra bright bluish-green, shining; antennæ pale, the outer joints fuscous; abdomen and metasternum piceous; legs yellowish, the hind femora often darker. Thorax nearly twice as wide as long, surface very finely, sparsely and indistinctly punctured. Elytra slightly wider at base than thorax, umbone rather prominent, smooth; surface finely, closely and indistinctly punctured on disk, smoother at sides and apex. Length 2-2.5 mm.

Frequent, seldom destructive. Small and very beautiful species. Collected by sweeping herbage near lakes at Lakeland, Md. This species does not attack cruciferous plants, differing from the preceding species of the genus in this respect.

VII. Haltica Geoff., 1764.

Medium-sized, blue, green or bronzed, rarely reddish-brown, species, having the head short, usually deeply inserted; antennæ half as long as body, joints 2, 3 and 4 gradually longer except in *rufa;* thorax usually one-half wider than long, broadest at base, which is curved and with a more or less distinct transverse line just in front; side margins slightly thickened near front angles; elytral punctures confused; front coxal cavities open behind, the prosternum rather narrow between the coxæ; hind tibiæ not or feebly sulcate, terminated by a short spur; tarsal claws broadly dilated at base.

36. Haltica rufa Illig., Mag. fur Insect., VI, 1807, 153.

Oval, broader behind, moderately convex. Dull reddish- or orange-yellow above, piceous beneath; antennæ and legs piceous, the hind femora paler at base. Antennæ half as long as body, third joint distinctly longer than fourth. Thorax nearly twice as wide at base as long, feebly narrowed to the front, margins very narrow; ante-basal impression broad and shallow; surface sparsely and finely punctate. Elytra slightly wider at base than thorax; umbone feebly, surface indistinctly and sparsely punctate. Length 4-5 mm.

Rare: Occasionally found feeding on ash.

Two specimens were in the Maryland State College collection, both badly mutilated. Not collected by the writer during four years' intermittent collecting.

37. Haltica chalybea Illig., Mag. fur Insect., VI, 1807, 115.

Oval, rather robust. Metallic blue, shining, rarely cupreous or greenish; under surface and legs blue-black; antennæ piceous, the basal half with metallic lustre. Thorax a little more than half wider than long, margins narrow, slightly thickened in front; disk convex, the ante-basal impressed line rather deep, extending from margin to margin; surface with minute scattered punctures. Elytra scarcely wider at base than thorax, umbone rather prominent, smooth; surface sparsely punctate, nearly smooth near apex. Length 4-5 mm.

Synonymy: *vitivora* Thomas.

Food plants: Wild and domestic grape, poison ivy, plum, apple, pear, quince, elm, blue or water beech (*Carpinus*), Virginia creeper (*Ampelopsis quinquefolia*).

Exceedingly common and very destructive to grape foliage in our fauna.

38. Haltica ignita Illig., Mag. fur Insect., VI, 1807, 117.

Oval, slightly oblong, subdepressed. Color exceedingly variable from a coppery golden lustre, through greenish to dark blue; under surface and legs colored as above. Thorax one-half wider than long, very little narrowed in front, sides feebly curved, ante-basal impression deep, extending from margin to margin; surface minutely and sparsely punctate. Elytra distinctly wider at base than thorax, umbone rather prominent, limited within by a depression; surface distinctly and sparsely punctate near base, gradually smoother to apex. Length 3-4 mm.

Synonymy: *kalmiæ* Mels.
inærata Lec.

Food plants: *Gaura sinuata*, strawberry, cabbage, lettuce, elm, sugar beet, crape myrtle (*Lagerstræmia indica*), rose, lilac, grape, Virginia creeper (*Ampelopsis quinquefolia*), water purslane (*Ludwigia palustris* Ell.) and numerous weeds and grasses.

Very common: Destructive to a large variety of food plants.

39. Haltica amœna Horn, Trans. Amer. Ent. Soc., XVI, 1889, 225.

Oblong oval, moderately convex, cupro-æneous, shining. Antennæ slightly longer than the body, fuscous, joints 2-3-4 gradually longer. Head smooth, frontal carina moderately prominent, tubercles distinct, oblong. Thorax one-third wider than long, distinctly narrowed in front, sides arcuate, margin narrow, distinctly thickened near the front angles, disk convex, ante-basal impression sharply defined, but gradually evanescent at its extremities, surface shining, not visibly punctulate, except with very high power. Elytra a little wider than the thorax, humeri obliquely rounded, umbone feebly, surface very finely alutaceous, relatively coarsely, but not closely punctate, the punctures at apex nearly as coarse as at base. Body beneath colored as above; abdomen moderately closely punctate. Length .12 inch; 3 mm.

Very rare: A very small and inconspicuous species which Ulke records from the District of Columbia but was never collected by the writer in College Park or vicinity.

40. Haltica cuprascens Blatchley, Beetles of Ind., 1910, 1202.

Oval, strongly convex. Coppery red, strongly shining; antennæ, legs and under surface piceous-bronzed. Thorax about one-third wider than long, scarcely narrowed in front, sides feebly curved, margin narrow, thickened at the front angles; disk finely alutaceous, sparsely and minutely punctate, the ante-basal impression very shallow, evident only at middle. Elytra one-third wider at base than thorax, sides

broadly curved; surface finely and sparsely punctate, very indistinctly so on apical third. Length 3.5-4 mm.

Rare: Not heretofore recorded from our fauna. Two specimens in the McDowell collection at Maryland State College answer this de scription.

According to Blatchley they probably occur on cottonwood.

41. Haltica marevagans Horn, Trans. Amer. Ent. Soc., XVI, 1889, 226.

Oval, slightly oblong, moderately convex, deep blue, rarely slightly greenish, shining. Antennæ half as long as the body, obviously thicker externally, piceous, bluish at base, joint four distinctly longer than third and equal to fifth. Head smooth, frontal carina scarcely prominent, the tubercles flat and indistinct. Thorax more than half wider than long, sides arcuately narrowed to the front, margin very narrow, slightly thickened at front angles, disk convex, ante-basal impression extremely indistinct, often entirely obliterated, surface sparsely, finely punctate near the base, an oblique series of coarser punctures beginning at the front angles. Elytra a little wider at base than the thorax, humeri rounded, umbone feeble, a slight flattening within it, surface finely, not closely, but very distinctly punctate, smoother near the apex. Body beneath and legs colored as above; abdomen coarsely, not closely punctate. Length .16-.18 inch; 4-4.5 mm.

Rare: Food plants not known. One specimen was collected in a flood at Bladensburg.

42. Haltica fuscoænea Melsh., Proc. Phil. Acad. Nat. Sci., III, 1847, 165.

Oblong-oval, convex. Olivaceous green or bronzed, strongly shining; under surface and hind femora piceous with bronzed lustre; antennæ and legs reddish-yellow, the former with apical half darker. Thorax subquadrate, very little wider than long, not narrower at apex than base; sides very feebly curved; disk convex, very finely alutaceous, sparsely and minutely punctate. Elytra slightly wider at base than thorax, less than twice as wide as long, umbone not distinct; surface distinctly and sparsely punctate near base, smoother near apex, the punctures sometimes in more or less evident rows. Length 2.5-3 mm.

Scarce: Five specimens collected on evening primrose (*Œnothera biennis* L.).

VIII. Luperaltica Crotch, 1873.

This genus contains one small species. It has the front carinate between the antennæ and with flattened tubercles between the eyes; antennæ slender, longer than half the body, first joint stout, second small, oval, third twice as long, joints 3 to 10 equal; thorax convex with a vague transverse basal impression; epipleura reaching nearly to sutural angle; front coxal cavities open behind; first joint of hind tarsi as long as the next three.

43. Luperaltica fuscula Lec., Proc. Phil. Acad. Nat. Sci., 1865, 206.

Fuscous, subopaque; head yellow in front; tubercles well marked, separated from the front which is pitchy; thorax subquadrate, sides rounded in front, hind angles acute, base produced, broadly and faintly trifoveolate, disk obsoletely punctulate; elytra parallel, margin acutely reflexed, with a marginal series of evident punctures; disk obsoletely punctulate. Length 2.5-4 mm. Fifth segment of male with a broad obtusely truncate appendage.

Scarce: Four specimens in McDowell collection at Maryland State College.

IX. Lactica Er., 1847.

Small oval yellow or blue and yellow species having the head inserted in the thorax as far as the eyes; antennæ longer than half the body, third joint shorter than fourth, joints 4 to 10 equal, 11th very little longer. Thorax with a deep, transverse impression near the base, which is bent at each end abruptly toward the base; front coxal cavities open behind; tarsi more than half the length of the tibiæ, the claws appendiculate.

44. Lactica tibialis Oliv., Ent., VI, 1808, 697.

Oblong oval, moderately convex, entirely pale yellow, surface shining. Antennæ piceous, two basal joints yellow. Head very sparsely punctulate. Thorax nearly twice as wide at base as long, distinctly narrowed in front, sides arcuate, margin narrowly explanate, front angles very obliquely truncate, disk convex, sparsely, finely punctate. Elytra scarcely wider at base than the thorax, humeri rounded, umbone not prominent, disk moderately convex, not gibbous near the base, punctation fine, indistinct and moderately close. Body beneath entirely yellow; abdomen moderately closely punctate and sparsely pubescent. Femora yellow, except the upper side of knees, tibiæ and tarsi piceous. Length .14-.16 inch; 3.5-4.5 mm.

Synonymy: *ocreata* Say
xanthochroa Harold

Rare: Often mistaken for *Haltica rufa*, but independent of the deep basal impression, the form is more elongate and the color always paler. A species of wide distribution, but not destructive. Two specimens were collected in a flood at Bladensburg and one by sweeping marshland in College Park.

45. Lactica iris Oliv., Ent., VI, 1808, 702.

Oval, slightly oblong, moderately convex. Head and thorax yellow; elytra deep violet blue, shining; antennæ piceous, three basal joints pale; thorax beneath and front and middle legs pale yellow; metasternum, abdomen and hind legs piceous. Thorax about twice as wide as long, mar-

gins narrow; disk convex, not visibly punctate. Elytra not wider at base than thorax, umbone rather prominent, surface very finely punctate. Length 3.5-4 mm.

Frequent: Found only on the passion flower (*Passiflora lutea* L.).

X. Diphaulaca Clark, 1865.

Head inserted in the thorax as far as the eyes, the front obtusely carinate and with distinct tubercles, clypeus slightly emarginate, labrum slightly arcuate in front, maxillary palpi rather slender, the terminal joints as long as the preceding, acute. Antennæ slender, at least half as long as the body. Thorax broader than long, narrower in front, the sides arcuate, anterior angles obliquely truncate (in our species), the ante-basal impression deep, slightly sinuous, limited each side by a short longitudinal impression. Elytra oval, wider at base than the thorax, disk coarsely striato-punctate. Prosternum moderate, slightly dilated at apex, the coxal cavities widely open behind. Legs moderate. tibiæ slightly broader to apex, the outer face slightly grooved near the apex, the posterior pair alone with a small spur. Tarsi moderate in length, the first joint of the posterior pair nearly one-third the length of the tibiæ. Claws appendiculate.

46. Diphaulaca bicolorata Horn., Trans. Amer. Ent. Soc., XVI, 234.

Oval, moderately convex, head, thorax and legs reddish-yellow, elytra and abdomen piceous black with faint purple lustre. Antennæ rufotestaceous, slightly darker externally. Head smooth. Thorax nearly twice as wide at base as long, narrowed in front, sides arcuate, anterior angles obliquely truncate, disk convex, very sparsely punctate. Elytra wider at base than the thorax, humeri rounded, umbone small, smooth, disk moderately convex, coarsely striato-punctate, punctures closely placed and deep, those near the suture very irregular, although variable in the specimens, intervals smooth, metasternum and abdomen piceous black, shining, the latter sparsely punctate. Legs pale rufotestaceous, the posterior femora slightly darker. Length .08 inch; 2 mm.

Very rare: Two specimens were collected at College Park by sweeping.

XI. Sphæroderma Steph., 1834.

Head triangular, deeply inserted in the thorax, front obtusely carinate, the callosities small, clypeus truncate, labrum feebly emarginate at middle. Maxillary palpi with second joint slender, third short, obconical, fourth a little longer, acute. Eyes moderately prominent, round. Antennæ half as long as the body, slightly thicker toward tip, first joint slightly clavate, second and third equal, together as long as the first, 4-10 nearly equal, gradually wider, eleventh longer, acuminate at tip. Thorax transverse, anterior angles rounded, the posterior obtuse, margin narrowly explanate. Elytra not wider at base than the thorax, punctation generally confused, substriate in places, epipleuræ horizontal. Legs moderate, hind thighs broadly oval. The tibiæ broader at apex, the posterior grooved on the outer face near the apex and with a small terminal spur, and distinctly prolonged on the inner side beyond the insertion of the tarsus. First joint of hind tarsi as long as the following together, the claws broadly appendiculate at base.

47. Sphæroderma opima Lec., Proc. Phil. Ent. Soc., 1878, 417.

Orbicular, convex, piceous black, shining, front of head a little paler. Antennæ slender, pale rufotestaceous. Head closely punctate. Thorax more than twice as wide as long, rapidly narrowed in front, the sides nearly straight, rounded at the front angles, finely, moderately, closely punctate.

Elytra not wider at base than the thorax, humeri broadly rounded, umbone feeble, the disk with coarse not close punctures forming rather irregular striæ at middle but quite regular at the sides, intervals more finely punctulate. Epipleuræ paler. Body beneath piceous, tibiæ and tarsi reddish-brown. Length .10 inch; 2.5 mm.

Rare: A single specimen was collected near Bladensburg by sweeping along the roadside.

SUBTRIBE B. (*Chætocnemini.*)

The members of this subtribe are separated from the preceding only by the closed cavities of the front coxæ. They are, for the most part, very small oval or oblong species, with the upper surface usually uniform in color. Although the two subtribes are each probably represented in College Park by about the same number of genera, the present one has much the fewer species.

XII. **Hypolampsis** Clark, 1860.

Small oblong-oval, convex, brown or piceous hairy species, having the antennæ half the length of the body, the second joint oblong-oval, as stout as the first but shorter, third more slender and longer than second, 4, 5 and 6 gradually shorter, 7 to 11 abruptly broader; prosternum narrow between the coxæ, dilated behind them; hind tarsi nearly as long as tibiæ, first joint obconical, very narrow at base, fourth abruptly inflated at apex, the claws toothed at middle; claws of front and middle tarsi bifid.

48. Hypolampsis pilosa Illig., Mag. fur Insect., VI, 1807, 105.

Oblong-oval, convex. Dull brownish-yellow to piceous, opaque; surface with prostrate gray and brown pubescence and sparse erect hairs; antennæ reddish or brownish-yellow, the outer five joints darker. Thorax quadrate, very little wider than long, sides nearly straight; disk convex, coarsely and closely punctate and with two feeble elevations slightly in front of middle. Elytra wider at base than thorax; disk with a faint oblique impression from humerus to suture near middle, ending in a shallow black fovea on first and second striæ; punctures coarse, close-set and deep, arranged in regular rows; intervals not wider than the distance between the punctures. Length 2.5-4 mm.

Frequent at times but not common: Several specimens collected in a flood near Bladensburg and four specimens collected by beating and sweeping on the edge of pine forest. One specimen labeled *Maryland* in McDowell collection. Food plant not known.

XIII. **Pachyonychus** Chevr., 1834.

Represented in the eastern United States by a small, oblong, parallel smooth species, having the antennæ a little longer than half the body, the second and third joints short, nearly equal in length, together longer than first, but shorter than fourth, joints 5 to 10 equal, not thickened as in the preceding genus; hind tarsi moderately long, the first two joints triangular, the fourth inflated at apex.

49. Pachyonychus paradoxus Melsh., Proc. Phil. Acad. Nat. Sci., III, 1847, 163.

Oblong, nearly parallel. Reddish-yellow, elytra piceous, the suture narrowly reddish-yellow; antennæ black, the three basal joints paler. Thorax convex, more than one-half broader than long, not narrowed in front, sides feebly curved, margins thickened at front angles, hind angles dentiform; surface sparsely and deeply punctate, the impression near base deep and extending from side to side. Elytra wider at base than thorax, the punctures of striæ coarse and closely placed; intervals slightly convex, each with a row of very fine punctures. Length 3-4.5 mm.

Frequent: Often taken in numbers on greenbrier (*Smilax rotundifolia*). Three specimens were collected hibernating under pine brush.

XIV. Blepharida Rogers, 1856.

Here belongs a single robust, oval species having the antennæ rather widely separated at base, half as long as body, first four joints smooth, the second half as long as first; third and fourth slender, each longer than second; 5 to 10 broader than fourth, gradually very slightly shorter and pubescent, 11th longer and with a very small conical terminal joint; hind tibiæ sinuate and deeply grooved on outer edge near apex; tarsi stout, first joint broadly triangular, fourth slender.

50. Blepharida rhois Forst., Nov. Spec. Ins., 1771, 21.

Short, robust, oval, convex. Under surface and legs reddish-brown; above dull yellow, the elytra paler, irregularly variegated with dark reddish-brown; antennæ piceous, the four basal joints paler. Thorax more than twice as wide as long, narrowed in front, sides regularly curved, front angles prominent, hind ones obtuse; disk sparsely and finely punctured and with a row of coarser punctures around the margins. Elytra scarcely wider at base than thorax, each with nine feebly impressed rows of coarse, deep, distant punctures. Length 5-6.5 mm.

Synonymy: *stolida* Fabr.
virginica Frohl.
meticulosa Oliv.

Frequent: Very common on sumac, *Rhus continus*.

The larvæ of this species have the singular habit of covering themselves with their exuded excrement. One of our largest species of flea-beetles; frequent, but not of economic importance.

XV. Chætocnema Steph., 1831.

Small elongate or oval, black or brown, usually faintly bronzed species having the head immersed in thorax to eyes, the front not carinate; antennæ slender, at least half the length of body, second joint elongate-oval, 3 to 6 slender and longer, 7 to 11 gradually broader and flattened, the 11th nearly as long as the two preceding, acute at tip; thorax always broader than long, narrowed in front, base regularly curved, without an impression in front; elytra at most but little wider than thorax, their punctures in rows; hind tibiæ sinuate near apex, with a triangular tooth above the curve, grooved at apex on the outer side and terminating in a rather long, stout spur; tarsal claws simple.

51. Chætocnema subcylindrica Lec., Proc. Amer. Phil. Soc., 1878, 419.

Oblong, nearly parallel, more than twice as long as broad, piceous, surface with æneous bronze lustre. Antennæ piceous, three basal joints paler. Head alutaceous, punctures not coarse nor closely placed, a smooth median space, front not densely punctured. Thorax about one-third wider than long, widest at middle, apex not narrow, sides rather strongly arcuate, disk convex, a slight depression along the base, punctures moderately coarse and close, coarser along the sides and base, surface not distinctly alutaceous. Elytra a little wider at base than the thorax, humeri rounded, umbone scarcely prominent, disk with rows of moderately coarse punctures closely placed, but not serrate, the scutellar and first two discal striæ irregular at base, outer striæ not impressed, intervals not convex, wider than the striæ and smooth, epipleural fold with numerous punctures, biseriate at base. Prosternum coarsely, not densely punctate, side pieces with numerous coarse punctures. Body beneath piceous, shining. Abdomen sparsely punctate, more closely on last segment. Legs piceous, the tibiæ and tarsi dark brown. Length .08-.10 inch; 2-2.5 mm.

Scarce: Occasionally occurs in numbers but is not destructive. Five specimens were collected by sweeping in meadowland near Bladensburg.

52. Chætocnema protensa Lec., Proc. Amer. Phil. Soc., XVII, 1878, 417.

Form given in key. Piceous, distinctly brassy-bronzed; tibiæ, tarsi and basal half of antennæ reddish-yellow. Head coarsely, not closely punctate. Thorax one-third wider at base than long, sides regularly curved, feebly narrowing to apex; disk minutely alutaceous, rather finely and sparsely punctate. Elytra slightly wider at base than thorax, with regular rows of rather coarse, close-set punctures; intervals flat, wider than striæ, without punctures. Length 2.5-2.8 mm.

Rare: Two specimens collected by sweeping in clover and orchard grass at Glendale, Md., in meadowland.

53. Chætocnema denticulata Illig., Mag. fur Insect., VI, 1807, 163.

Oblong-oval, robust. Piceous-bronzed, slightly brassy; antennæ reddish-yellow at base, the outer five or six joints piceous; front and middle femora brown, hind ones piceous bronzed; tibiæ and tarsi reddish-yellow. Head and thorax alutaceous; the latter nearly twice as wide at base as long, sides, regularly curved to apex; surface rather coarsely and regularly but not densely punctured, the basal marginal

line feeble at the sides. Elytra not wider at base than thorax, the punctures coarse and deep, not closely placed; intervals nearly flat on disk, subconvex on sides, each with a row of very fine punctures. Length 2.3-2.5 mm.

Synonymy: *semichalcea* Melsh.
americana Mots.
texana Crotch.

Food plants: Crab-grass (*Eleusine* sp.), radish, turnip, corn, spinach, cabbage, garden beet, millet.

Abundant and destructive.

54. Chætocnema minuta Melsh., Proc. Phil. Acad. Nat. Sci., III, 1847, 167.

Oval, robust. Piceous, distinctly bronzed, shining; antennæ with four basal joints brownish-yellow, the remainder piceous; legs piceous, the tibiæ and tarsi sometimes paler. Head distinctly alutaceous, indistinctly punctate. Thorax twice as wide as long, widest at middle, disk faintly alutaceous, finely and sparsely punctured; basal row of punctures distinct and coarse. Elytra distinctly wider at base than thorax, punctures coarse, rather closely placed, slightly broader than long; intervals feebly convex, without punctures. Length 2 mm.

Scarce: Six specimens collected in marsh near Bladensburg. Probably abundant at intervals.

55. Chætocnema parcepunctata Crotch, Proc. Phil. Acad. Nat. Sci., 1873, 74.

Oval, robust. Piceous-bronzed, shining; tibiæ, tarsi and base of antennæ paler. Thorax twice as wide as long, sides curved; disk finely alutaceous, sparsely and rather finely punctate. Elytra one-fourth wider at base than thorax, striæ feebly impressed, the rows of punctures large, round and rather close-set; intervals narrow, not punctate. Length 1.5 mm.

Frequently collected by sweeping meadowlands in Bladensburg. Also collected in numbers in a flood during May, 1912.

One of the smallest species found in our fauna.

56. Chætocnema pulicaria Melsh., Proc. Phil. Acad. Nat. Sci., III, 1847, 167.

Oval, slightly oblong, convex. Black, shining with faint greenish or bluish-bronzed lustre; antennæ with three or four basal joints reddish-yellow, the remainder piceous; femora piceous, tibiæ and tarsi brownish-yellow. Head and thorax alutaceous, the latter one-half wider at base than long, distinctly narrowed in front, basal marginal line punctured to near middle; surface very finely, sparsely and shal-

lowly punctured. Elytra a little wider at base than thorax, umbone smooth, distinct, punctures rather coarse and closely placed; intervals slightly convex, each with a row of minute punctures. Length 1.5-1.8 mm.

Synonymy: *æneola* Lec.

Food plants: Sugar corn, garden beet, and occasionally potato.

Scarce, but occasionally taken in numbers by sweeping in meadowland.

57. Chætocnema crenulata Crotch, Proc. Phil. Acad. Nat. Sci., 1873, 74.

Form oval, convex, robust, the thoracic and elytral margins almost exactly continuous, piceous, faintly bronzed, shining. Antennæ rufotestaceous. Head extremely finely alutaceous, impunctate. Thorax twice as wide at base as long, distinctly narrowed in front, sides feebly arcuate, the basal marginal line distinct, defined by a row of closely placed, fine punctures, the disk very distinctly alutaceous, the punctures coarse, deep, sparsely and rather irregularly placed. Elytra not wider than the thorax at base, humeri smooth, not prominent, striæ scarcely impressed, the punctures large, deep and moderately closely placed, intervals wider than the striæ, shining, slightly convex, very indistinctly uniseriately punctulate. Body beneath piceous black, faintly bronzed. Prosternum smooth, the side pieces smooth. Abdomen not distinctly punctate, except at the sides of the last segment. Femora piceous, bronzed, tibiæ and tarsi rufotestaceous. Length .06-.08 inch; 1.5-2 mm.

Rare: Recorded by Ulke in his list as occurring in the District of Columbia, but has never been collected by the writer in our fauna.

58. Chætocnema confinis Crotch, Proc. Phil. Acad. Nat. Sci., 1873, 74.

Broadly oval, robust. Piceous, slightly bronzed; antennæ and legs reddish-yellow; hind femora piceous. Head finely alutaceous, not punctured. Thorax twice as wide as long, distinctly narrowed in front; disk alutaceous, rather coarsely and regularly but not closely punctured. Elytra scarcely wider at base than thorax, the striæ more deeply impressed on sides, punctures rather coarse, close and deep; intervals slightly convex, minutely punctate. Length 1.5-1.8 mm.

Synonymy: *flavicornis* Lec.

Food plants: Morning-glory (*Ipomœa purpurea*), sweet potato, and occasionally garden beet.

Abundant and destructive, especially to sweet potato vines.

59. Chætocnema quadricollis Schwarz, Proc. Amer. Phil. Soc., 1878, 368.

Form oval, not very convex, piceous black, with faint æneous lustre. Antennæ entirely rufotestaceous. Head alutaceous, impunctate. Thorax nearly twice as wide as long, very obliquely truncate at the front angles, the sides behind the angulation nearly straight and slightly convergent to base, the basal marginal line distinct, entire, disk distinctly alutaceous, the punctures feebly impressed and not closely placed. Elytra wider at base than the thorax, humeri rounded, umbone moderately prominent and smooth, striæ slightly impressed, the punctures moderate in size and closely placed, intervals wider than the striæ, slightly convex, each with a series of distant fine punctures, surface not alutaceous. Body beneath piceous shining. Prosternum punctate, the side pieces smooth. Abdomen sparsely, indistinctly punctate. Legs usually entirely pale rufotestaceous, the posterior femora sometimes slightly darker. Length .06-.08 inch; 1.5-2 mm.

Food plant: *Hibiscus militaris.*

Very rare: Recorded as having been found during July feeding on *Hibiscus militaris* in the District of Columbia. This plant does not occur in College Park, hence the writer failed to collect this species.

XVI. Crepidodera Chevr., 1834.

Small oval or oblong-oval brownish, greenish or blackish-bronzed species, having the front more or less triangular, inserted in thorax to the eyes; antennæ half as long as body, second joint half as long as first, 3 to 10 subequal, a little longer than second and gradually slightly broader to eleventh, which is longer and acute at tip; thorax broader than long, the antebasal impression limited at each end by a longitudinal one; first ventral segment as long as the next three; hind tibiæ obliquely truncate and with a small spur.

60. Crepidodera rufipes Linn., Syst. Nat., X, 1765, 373.

Oblong-oval, nearly parallel. Head, thorax and legs dull reddish-yellow; elytra dark blue, shining; metasternum and abdomen piceous. Thorax nearly twice as wide as long, sides straight and parallel behind the middle, rounded to apex in front; disk convex, smooth. Elytra a little wider at base than thorax, umbone rather prominent and smooth; each with a long scutellar row and nine discal rows of coarse, closely placed punctures; intervals narrower than the striæ, slightly convex. Length 2.5-3 mm.

Synonymy: *erythropus* Melsh.

Food plants: Black locust (*Robinia*), peach and apple foliage, also apple buds.

Frequent and sometimes destructive: A very pretty species introduced into this country from Europe.

61. Crepidodera helxines Linn., Syst. Nat., X, 1765, 373.

Oblong-oval, moderately convex. Metallic bronzed, blue or green; antennæ and legs reddish-yellow, hind femora often darker; under surface piceous. Thorax more than half wider than long, not narrowed in front, sides very feebly curved; ante-basal impression deep and at each end suddenly bent towards base, surface coarsely and unequally punctate. Elytra distinctly wider at base than thorax, umbone rather prominent, punctures rather coarse, becoming finer towards apex; intervals very minutely punctate. Length 2.5-3.3 mm.

Synonymy: *nana* Say
violacea Melsh.
areola Lec.
opulenta Lec.

Food plants: Willow, apple, pear, sugar beet, Cratægus, elm, poplar. Abundant on willow trees. A very pretty metallic green species, varying greatly in size and depth of color.

62. Crepidodera atriventris Melsh., Proc. Phil. Acad. Nat. Sci., III, 1847, 165.

Short, broadly ovate, convex. Dull reddish-yellow; antennæ and legs paler. Thorax twice as wide as long, sides feebly curved, obliquely truncate near front angles and with a slight angulation one-third from apex; disk convex, not punctured. Elytra wider at base than thorax, umbone distinct; punctures coarse, rather closely placed on base, finer toward apex. Length 1.5-1.8 mm.

Abundant in grassy fields, but not destructive. Recorded on May-apple by Blatchley. One of our smallest species, but its lighter color readily distinguishes it from other smaller species in our fauna. Numerous specimens were collected by sweeping meadowland.

XVII. Orthaltica Crotch, 1873.

Small, elongate, parallel, brownish or piceous beetles, having the antennæ nearly as long as body, male, shorter in female, the second joint half as long as first; the others dissimilar in the sexes. Thorax broader than long, scarcely wider at base, apex truncate, sides and base curved, disk with a rather deep ante-basal impressed line, not limited at the ends, which gradually approach the base; first ventral segment as long as the next three; hind tibiæ with a short spur.

63. Orthaltica copalina Fabr., Syst. Eleut., I, 1801, 466.

Elongate-parallel, subconvex. Brownish or piceous, shining; when piceous the head and thorax paler; antennæ and legs reddish-yellow. Antennæ of male with third and fourth joints equal, a little longer than second, fifth longer than either fourth or sixth, 6 to 10 gradually shorter and stouter, 11th one-half longer than 10th and acuminate at apex; in female joints 4 to 10 are equal, shorter than third and slen-

der. Thorax one-half wider than long, base scarcely broader than apex, margins finely serrate; surface rather sparsely but deeply and coarsely punctate. Elytra distinctly wider than thorax, umbone prominent; disk with nine rows of coarse, closely placed punctures, those of the inner rows confused at base; intervals slightly convex. Length 2-3 mm.

Common on sumac (*Rhus sp.*). Blatchley also records it feeding on Hercules' club (*Aralia spinosa*, L.). A small species with long antennæ. Numerous specimens collected on sumac near Berwyn, Md.

XVIII. Epitrix Foud., 1859.

Very small convex species, differing from *Crepidodera* in the upper surface bearing short, semi-erect hairs, sparsely placed over the thorax and arranged in a single row on each interval of the elytra. The head has an oblique ridge each side, extending from the end of the frontal carina to the eye and limited above by an impressed line, the two forming together a broad V. The front angles of the thorax are obliquely truncate with a small tooth behind the truncation.

This genus includes many of our most injurious species.

64. Epitrix fuscula Crotch, Proc. Phil. Acad. Nat. Sci., 1873, 72.

Ovate, rather robust, convex. Piceous, feebly shining; antennæ reddish-yellow, often darker towards apex; femora all piceous, tibiæ and tarsi dull reddish-yellow. Thorax twice as wide as long, slightly narrowed in front; ante-basal impression narrow, sinuate, often almost obsolete; surface coarsely, densely and deeply punctured. Elytra scarcely wider at base than thorax, umbone rather prominent, punctures on middle round, not crowded, those on sides deep, more closely placed; intervals as wide as or wider than striæ, each with a single row of minute setæ bearing punctures. Length 2 mm.

Food plants: Eggplant, horse-nettle (*Solanum carolinense* L.), thistle (*Cnicus* sp.), potato, tomato, jimson weed (*Datura stramonium*). Blatchley also records it on hazelnut and pokeweed (*Phytolacca decandra* L.). Very abundant and often destructive to eggplant.

65. Epitrix cucumeris Harris, Mass. Journ. Agr., 1851, 103.

Ovate, slightly oblong. Piceous, shining; antennæ and legs reddish-yellow, the hind femora only piceous. Thorax nearly twice as wide as long, slightly narrowed in front, ante-basal impression deep and slightly curved toward the base, the longitudinal impressions at its ends well marked; surface much more finely and sparsely punctured than in *fuscula*. Elytra slightly wider at base than thorax, umbone rather prominent, striæ feebly impressed, the punctures large and closely placed. Length 1.5-2 mm.

This species and *fuscula* are often confused unless closely examined. It is readily distinguished, however, by its somewhat smaller size, less pubescence and is much less densely punctured on its dorsal surface.

Synonymy: *pubescens* (pars) Illig.
seminulum Lec.

Food plants: Potato, tomato, sunberry (wonderberry), tobacco, thistle (*Cnicus* sp.), eggplant, *Physalis virgiana,* cauliflower, *Datura stramonium,* cucumber, radish, turnip, *Solanum purpureum,* cabbage, petunias, beans, corn, lettuce, peas, beets, strawberry, pepper.

Very abundant, destructive, and an exceedingly omnivorous species.

This small flea-beetle is undoubtedly the most destructive species to plant-life in our fauna. Its larvæ cause "pimply" potatoes, and the adults riddle small holes in potato foliage, giving the plants a blighted appearance. This flea-beetle ranks next to the Colorado potato beetle (*Leptinotarsa decemlineata* Say) as a potato pest in our fauna.

66. Epitrix parvula Fabr., Syst. Eleut., I, 1801, 468.

Oblong-oval, subconvex. Dull reddish-yellow; elytra often with a fuscous transverse cloud at middle; abdomen brown; antennæ and legs pale reddish-yellow, the four outer joints of former and hind femora of latter often darker. Thorax convex, shining, nearly twice as wide as long, not narrowed in front; ante-basal impression evident, but not deep; surface distinctly but rather finely and sparsely punctate. Elytra very little wider than thorax, umbone feeble, punctures rather coarse and not crowded on disk; finer and more close-set on sides, where the intervals are subconvex. Length 1.5-2 mm.

Synonymy: *hirtipennis* Melsh.

Food plants: Potato, jimson weed, (*Datura stramonium*), eggplant, sugar beet, tomato, *Physalis,* cape-gooseberry, tobacco, bell pepper, (*Solanum nigrum*), *Solanum melongena, Solanum carolinense* L., lettuce, *Atropa belladonna.*

Very abundant and destructive, especially to tobacco. Like the preceding species, this flea-beetle is quite omnivorous. It is readily distinguished from the preceding species (*cucumeris*) by its dull reddish-yellow color, but in general form and size the two species are quite similar.

XIX. Mantura Steph., 1831.

To this genus belongs a single small, elongate-oval, brownish species, having the antennæ slender, half as long as body, the outer five joints abruptly broader; thorax with a deep

longitudinal basal impression each side opposite the middle of each elytron and extending nearly half way to apex; first ventral segment nearly as long as all the others; tibiæ each with a small terminal spur; claws simple.

67. Mantura floridana Crotch, Proc. Phil. Acad. Nat. Sci., 1873, 73.

Elongate-oval, moderately convex. Brownish, with a bronzed lustre; elytra indefinitely paler on apical third; antennæ brownish, the basal joints paler; legs reddish-yellow, the hind femora darker. Thorax nearly twice as wide as long, widest at base, gradually narrowed in front; surface coarsely, deeply and rather closely punctate, more sparsely between the basal depressions. Elytra scarcely wider at base than thorax, umbone not prominent, disk ten rows of rather fine, deep punctures; intervals broader than striæ, smooth. Length 2 mm.

Scarce: One specimen collected by sweeping in a swamp near Bladensburg. Another specimen collected in flood near Bladensburg.

XX. Systena Chevr., 1834.

Small elongate, usually subdepressed species, having the antennæ slender, half as long as body, slightly thicker toward the tip, the fourth joint longer than the third or fifth. Thorax broader than long, very little narrowed in front, margins very narrow, hind angles acute, disk but vaguely impressed in front of base; front coxæ narrowly separated, the cavities closed behind; hind tibiæ grooved on outer edge and carinate, terminated by a single spur; claws appendiculate.

68. Systena hudsonias Forst., Nov. Sp. Ins., 1771, 26.

Elongate, subdepressed. Piceous black, shining; antennæ with joints 3, 4 and 5 dull yellow, the others more or less piceous; legs black. Thorax about one-third wider than long, sides feebly curved, front angles obliquely truncate; surface finely alutaceous, indistinctly punctate, minutely wrinkled. Elytra wider at base than thorax; disk coarsely and closely punctate, somewhat rugose. Length 4-4.5 mm.

Synonymy: *frontalis* Illig.

Food plants: Wild aster, Coleus, canna, elder, grape, garden beet, occasionally potato and pole beans, and quite common on *Ambrosia trifida* L.

Abundant, but rarely destructive. Numerous specimens collected by beating and sweeping in moist meadow-lands near Bladensburg.

69. Systena frontalis Fabr., Syst. Eleut., I, 1801, 300.

Resembles *hudsonias* very closely. Usually a little broader and less shining, the head reddish or reddish-yellow; antennæ and legs mostly pale. Thorax more distinctly and elytra less coarsely punctate. Males in both species with the last ventral segment notched each side, the middle lobe with a deeply impressed triangular median line. Length 3.5-4.5 mm.

Food plants: Burdock, (*Arctium lappa L.,*) young corn, aster, Polygonum, *Ambrosia trifida* L., and Chenopodium, and very occasionally garden beets.

Rarely abundant and not destructive.

70. Systena elongata Fabr., Ent. Syst., Supp., 1798, 99.

Elongate-oval, moderately convex. Piceous with a slight bronzed lustre; elytra each with a yellow stripe on middle reaching nearly to apex; antennæ brownish; legs reddish, hind femora piceous. Head coarsely and closely punctate. Thorax one-fourth wider than long, sides feebly curved; disk convex, coarsely and closely punctate. Elytra distinctly wider at base and more finely and sparsely punctate than thorax. Length 3-4 mm.

Food plants: Tobacco, beets, turnip, beans, wild grape, and reported on cotton in the south.

Frequent and sometimes destructive to beets and turnips.

71. Systena tæniata Say, Long's Sec. Exped., 1824, 294; ibid. I, 195.

Elongate-oval. Color variable, usually reddish or brownish-yellow, shining; elytra each always with a paler median stripe; under surface and narrow margins of thorax usually piceous; antennæ and legs reddish-brown. Thorax one-fourth wider than long, sides feebly rounded, surface finely and sparsely punctured. Elytra distinctly wider than thorax, finely, shallowly and rather densely punctate. Length 3-4.5 mm.

Synonymy: *ligata* Lec.
ochracea Lec.
mitis Lec.
bitæniata Lec.
pallidula Boh.

Food plants: Sweet potato, turnip, cabbage, rape, sugar beet, okra, mustard, Swiss chard.

Abundant and often destructive to cabbage and turnip.

Variety *blanda* Melsh.:

Median pale stripe of elytra and slightly smaller size, readily distinguishes it from *tæniata*. The writer believes this variety should be recognized as a distinct species.

Food plants: Mustard, radish, sugar beet, beans, occasionally potato, chrysanthemum blossoms, melons, carrot, okra, cabbage, rape.

Abundant and sometimes destructive. The writer has witnessed severe injury to bean foliage by this flea-beetle.

72. Systena marginalis Illig., Mag. fur Insect., VI, 1807, 150.

Elongate-oval, subdepressed. Pale dull yellow, scarcely shining; sides of thorax and elytra very narrowly piceous;

antennæ with the terminal halves of the outer joints piceous. Head alutaceous, sparsely and regularly punctate. Thorax one-third wider than long, not broader at base than apex, sides regularly curved; disk coarsely, not closely punctured. Elytra distinctly wider at base than thorax, rather densely and coarsely punctate. Length 3.5-4 mm.

Synonymy: *oblonga* Lec.

Food plant: Oak.
Scarce: Occasionally occurs in numbers on oak.

XXI. Dibolia Chevr., 1834.

Small oval or oblong species having the head rounded, retracted within the apex of thorax; front carinate with distinct tubercles; antennæ at least half as long as body, the outer joints a little stouter; thorax broader than long, much narrowed in front; elytra oval, not wider than base of thorax, with regular rows of punctures; hind femora strongly dilated, tibiæ slender, broader and denticulate at tip, terminated by a rather long and broad spur which is deeply emarginate at tip; first joint of tarsi one-third the length of tibiæ; claws appendiculate.

73. Dibolia borealis Chevr., Guer. Icon. Regne Anim., 1845, 307.

Oval, slightly oblong, convex. Piceous bronzed, usually cupreous or bluish; antennæ and legs reddish-yellow, hind femora piceous, bronzed. Thorax twice as wide at base as long, apex but little wider than the length, sides curved; disk closely punctate with fine and coarse punctures intermingled. Sides of elytra continuous with those of thorax, umbone prominent; disk with rows of rather fine, close-set punctures, the third and sixth rows often in part confused; intervals broad and flat, the second, fourth and sixth with coarser punctures than the others. Length 3 mm.

Synonymy: *aera* Melsh.

Food plant: *Plantago major* L.

Abundant and destructive to the plantain weed. The writer has collected all stages of this species in large numbers on or near this weed.

XXII. Psylliodes Latr., 1825.

Head oval, deeply inserted; front nearly vertical without carina or distinct tubercles; antennæ 10-jointed, separated at base, joints 2, 3 and 4 nearly equal, 5 to 9 gradually slightly shorter, tenth longer, acute at tip. Thorax broader than long, narrowed in front, base broadly curved and with a distinct marginal line; hind femora much thickened, sulcate beneath for the tibiæ; hind tibiæ broader toward the apex, ending in a short spur, the tip prolonged beyond the union of the tarsi and with a border of short hairs; hind tarsi slender, first joint more than half the length of tibiæ; claws simple.

74. Psylliodes punctulata Melsh., Proc. Phil. Acad. Nat. Sci., III, 1847, 166.

Elongate-oval, little narrower in front, convex. Piceous or dark bronzed, shining; antennæ with three basal joints pale, the remainder brownish; front and middle femora piceous, the hind ones bronzed; tibiæ reddish-yellow, darker

at middle. Thorax one-half wider at base than long, obliquely truncate at front angles; disk alutaceous, rather coarsely but not densely punctate. Elytra not wider at base than thorax, punctures rather coarse; intervals slightly convex, each with a single row of fine punctures. Length 2.3-2.7 mm.

Synonymy: *parvicollis* Lec.
extricata (male) Casey.
œnescens Casey.

Food plants: *Chenopodium album* L., rhubarb, sugar beet, garden beet, radish, hops, potato, murole, cucumber, tomato, watermelon, mangel, mustard, nettle (*Urtica dioica* L.).

Abundant and often destructive to radish, rhubarb, and in the west to hops.

75. Psylliodes convexior Lec. Pac. R. R. Rep., 1857, 69.

Oblong-oval, moderately convex. Piceous, shining and distinctly bronzed; antennæ piceous, three basal joints paler; legs as in *punctulata*. Thorax nearly twice as wide at base as long, surface finely punctate at middle, a little more coarsely at sides. Elytra not wider at base than thorax; punctures rather coarse, well separated, becoming gradually finer toward apex; intervals flat, the inner three with numerous fine punctures, the outer ones each with but a single row. Length 2-2.5 mm.

Synonymy: *interstitialis* Lec.

Food plants: Turnip, mustard.

Abundant, but not destructive.

University of Maryland
Agricultural Experiment Station

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THE COMPARATIVE VALUE OF DIFFERENT FORMS OF LIME.

By A. G. McCall.

SUMMARY.

Lime is the key to soil fertility building since the economic use of both manure and commercial fertilizers is dependent upon the lime supply of the soil.

Maryland offers a variety of lime-bearing materials. The comparative value of some of these materials has been tested in different parts of the State with the following results:

At College Park Field (Prince George's County), where burned lime and burned oyster shell were compared with shell marl and with pulverized raw shell the shell marl gave the highest yield of wheat and hay, while the pulverized shell produced almost as much wheat and hay and an increased amount of corn.

At Branchville Field (Prince George's County), where the raw pulverized limestone and oyster shell were compared with the burned forms, the value of the increase for the entire period was as follows:

Pulverized raw oyster shell	$78.43
Burned oyster shell	73.85
Pulverized raw limestone	77.60
Burned Limestone	77.05

At Ridgely Field (Caroline County), the pulverized raw limestone has produced a larger yield of alfalfa hay than pulverized raw oyster shell, burned oyster shell or hydrated lime.

You are invited to send a sample of your soil to the Experiment Station for a lime requirement test. This service is free.

Maryland Soils Need Lime.

At least two-thirds of the farm land in Maryland must have an application of lime before maximum crops can be produced. The poor and unproductive land of the State is invariably sour, and many of the good soils could be made more productive by the liberal use of lime. When a soil begins to need lime it is a waste of time and energy to continue to cultivate it until this need has been supplied, since the economic use of both manure and fertilizers is dependent upon the lime supply of the soil.

Maryland offers a variety of lime-bearing materials, many of which are being used as a source of agricultural lime. In some sections of the State oyster shells are found in abundance, while in other parts of the State limestone rock furnishes an adequate supply of lime for the farm. Lime marls are found in abundance in many parts of Maryland and have been used for agricultural purposes for many years. These materials are usually available in three different forms, (1) raw pulverized oyster shell, pulverized limestone and marl; (2) burned limestone or oyster shell, and (3) hydrated lime or oyster shell. It is important, therefore, that we have some definite information as to the relative agricultural value of the lime from these different sources and the relative effectiveness of the different forms that are found upon the market. With these facts in mind the Maryland Agricultural Experiment Station many years ago started a series of tests in which some of these different forms of lime were applied to a field on which a rotation of corn, wheat and timothy and clover was being grown. More recently a series of experiments were started in which the different forms of lime were applied in varying amounts to field plots upon which wheat and corn were being grown in alternate years with crimson clover seeded after the wheat to be plowed down for down the following spring. A third test has been conducted to determine the relative effectiveness of different forms of lime when applied to land on which alfalfa is being grown.

College Park Field.

As early as 1895 a series of experiments were inaugurated at College Park for the purpose of studying the relative effectiveness of different forms of lime. The land selected for this test was a well-drained, sandy clay loam, well adapted to general farming or to the growing of truck crops. The field was laid out in plots ten feet wide and sixty-seven feet long, with a two-foot space between each pair of plots. The rotation followed on these plots was corn, wheat and mixed timothy and clover. All of the plots received a uniform application of commercial fertilizers and the same quantity of actual lime, the only variation being in the

form of the lime and the source from which it was derived. All of the lime was used as a single application at the beginning of the experiment.

Table 1* gives the average results for four crops of corn, three crops of wheat and four crops of hay.

TABLE 1.

EFFECT OF DIFFERENT FORMS OF LIME.

PLOT NO.	TREATMENT.	*Average of Four Crops of Corn (bu).*	*Average of Three Crops Wheat (bu).*	*Average of Four Crops of Hay (lbs).*
1	Burned lime (lumps fresh slaked but not harrowed into soil).	32.0	10.3	1398
2	Burned lime (lumps fresh slaked and harrowed into soil).	32.0	11.2	1690
3	Burned oyster shell not harrowed into soil).	32.5	10.6	2015
4	Burned oyster shell harrowed into soil).	31.8	11.8	1804
8	Shell marl.	36.2	14.5	2145
9	Pulverized raw oyster shell.	37.1	14.1	1982

A comparison of the yields of plots 1 and 2 with those of plots 3 and 4 shows a slight but insignificant difference in favor of the burned oyster shell lime. A comparison of plots 8 and 9 with plots 1, 2, 3 and 4 brings out the fact that the raw lime or the carbonate form gave better results than did the burned or caustic lime. Attention is called to the increased yield obtained from plot 8 by the use of lime marl. The marl used on this plot was procured near Seat Pleasant, in Prince George's County, and contained nearly 3 per cent. of potash in addition to the lime. The presence of potash in this material may serve to account for its superiority over the other forms of lime included in this test. This shell marl is very abundant in many parts of Southern Maryland and the Eastern Shore, and where it is readily accessible should be used in preference to the more expensive forms of lime.

Branchville Field.

In 1914 a series of tests were started at Branchville, Prince George's County, in which some of the different forms of lime were applied in varying amounts to field plots upon which wheat and corn were being

*Condensed from Maryland Experiment Station Bulletin No. 110 (1906), which is now out of print.

grown in alternate years with crimson clover seeded after the wheat and plowed down the following spring as a green manuring crop for corn. The soil upon which these plots were located is a heavy silty loam of the Sassafras type, rather low in fertility and possessing only fair natural drainage. All of the applications of lime were made at the beginning of the experiment and in amounts varying from one-half ton to a maximum of about five tons per acre. The field was divided into two series of plots, each plot being one-twentieth of an acre in size. The lime was applied to Series 1 in the fall of 1914 and harrowed into the surface soil after plowing for wheat. The plots of Series 2 received their applications of lime in the fall of 1915 after the land had been plowed for wheat.

The rotation practiced on this field is shown on the following diagram:

Table 2.

ROTATION ON BRANCHVILLE FIELD.

Year.	Series 1.	Series 2.
1914	Cowpeas, followed by wheat.	Cowpeas.
1915	Wheat, followed by crimson clover.	Corn, followed by wheat.
1916	Corn, followed by wheat.	Wheat, followed by crimson clover.
1917	Wheat, followed by crimson clover.	Corn, followed by wheat.
1918	Corn, followed by wheat.	Wheat, followed by crimson clover.
1919	Wheat, followed by crimson clover.	Corn, followed by wheat.
1920	Corn, followed by crimson clover.	Wheat, followed by corn.

Although crimson clover was seeded each year in accordance with the above program, it was found to be impossible to secure a satisfactory stand on this field, hence the supply of organic matter after the first season was confined almost exclusively to that supplied by the roots of the wheat and corn crops.

The different forms of lime used and the rates of application are given in Table 3.

TABLE 3.

FORMS OF LIME AND RATE OF APPLICATION.

PLOT NO.	FORM OF LIME USED.	*Rate of Application. Lbs. per Acre.*
1	Check, no lime	....
2	Pulverized raw oyster shell	9500
3	Pulverized limestone	7900
4	Burned limestone	4000
5	Burned oyster shell	4000
6	Pulverized raw oyster shell	4750
7	Pulverized limestone	3950
8	Check, no lime	....
9	Burned limestone	2000
10	Burned oyster shell	2000
11	Pulverized oyster shell	2375
12	Pulverized limestone	1910
13	Burned limestone	1000
14	Burned oyster shell	1000
15	Check, no lime	....

Both series received the same application of lime with the exception of plots 5, 10 and 14 of Series 1, all three of which received an equivalent amount of oyster shell, shown in Table 3, but in a slaked form. The following is the approximate analyses of the materials used on these plots:

Pulverized raw oyster shell.....75% calcium carbonate.
Pulverized raw limestone.....90 % calcium carbonate.
Burned oyster shell (slaked).....37% calcium oxide.
Burned limestone.....90% calcium oxide.

In Table 4 is given the yields of corn and wheat by years, the two series being grouped together. The corn yields for the years 1916 and 1918 are from Series 1, while those for 1917 and 1919 are for Series 2. In a like manner the wheat yields for the years 1915, 1917 and 1919 are from Series 1, while those for 1916, 1918 and 1920 are from Series 2.

Table 4.

EFFECT OF DIFFERENT FORMS OF LIME UPON THE YIELDS OF WHEAT AND CORN (BRANCHVILLE FIELD).

Plot No.	Treatment.	*Lbs. per Acre.*	Corn Yields.				Wheat Yields.					
			1916.	1917.	1918.	1919.	1915.	1916.	1917.	1918.	1919.	1920.
1	Check, no lime.....	....	42.9	5.1	38.3	8.4	4.4	6.3	26.0	....*	7.0	....*
2	Pulverized raw oyster shell.	9500	53.1	42.3	40.2	37.5	9.9	23.9	31.1	11.2	11.4	14.2
3	Pulverized limestone	7900	52.9	41.3	41.3	35.0	15.2	23.6	40.6	10.9	12.6	18.8
4	Burned limestone	4000	51.0	35.2	43.7	43.2	19.1	25.7	32.1	11.4	11.2	16.4
5	Burned oyster shell.....	4000	54.5	30.8	35.8	43.3	19.3	18.5	40.2	8.6	10.0	13.9
6	Pulverized raw oyster shell.	4750	48.3	36.6	39.0	49.3	10.1	21.6	20.3	9.0	13.9	14.6
7	Pulverized limestone	3950	53.5	34.0	41.2	43.1	11.9	21.5	27.1	7.9	10.8	14.8
8	Check, no lime.....	....	42.3	16.1	33.7	12.3	8.6	15.4	23.7	4.1	10.3	4.1
9	Burned limestone.....	2000	50.5	30.6	31.5	36.8	19.2	20.8	32.5	9.7	12.1	15.5
10	Burned oyster shell.....	2000	56.4	21.6	37.5	26.2	15.5	19.2	27.5	10.9	12.3	10.3
11	Pulverized raw oyster shell.	2375	36.6	26.4	32.0	27.1	17.1	18.5	40.6	13.0	6.7	9.4
12	Pulverized limestone.....	1910	59.4	20.4	38.6	22.9	4.7	13.9	24.5	6.9	10.3	7.2
13	Burned limestone	1000	53.1	14.3	36.0	12.6	9.7	16.3	44.0	6.5	9.7	5.0
14	Burned oyster shell.....	1000	61.6	20.0	45.7	12.4	15.4	14.3	47.9	6.2	10.2	4.6
15	Check, no lime.....	....	50.6	22.5	41.5	32.0	19.1	22.1	18.6	6.6	12.5	9.0

*Crop failure.

WHEAT ON BRANCHVILLE FIELD.

As the result of an application of pulverized raw oyster shell in 1915 the limed plot has yielded at the rate of 17.5 bushels per acre, while the unlimed plot has yielded 12.5 bushels.

Table 5 is a summary of results given in the previous table and shows the average increase in bushels per acre, the average value per acre of this increase and the total value of the increase per acre for the entire period, which includes four crops of corn and six crops of wheat.

In computing the value of the increases an arbitrary price of eighty cents per bushel for corn and one dollar per bushel for wheat has been used.

TABLE 5.

SUMMARY OF THE EFFECT OF DIFFERENT FORMS OF LIME UPON THE YIELD OF WHEAT AND CORN (BRANCHVILLE FIELD).

Plot No.	Treatments.	*Average Increase in Bus. Per Acre.*		*Average Value Per Acre of Increase.*		*Total Value of Increase for Entire Period.*
		Wheat.	*Corn.*	*Wheat.*	*Corn.*	
1	Check, no lime.....	....	....	....	....	.....
2	Raw oyster shell.....	8.1	14.4	$8.10	$11.52	$94.68
3	Raw limestone	11.4	13.8	11.40	11.04	112.56
4	Burned limestone.....	10.4	14.5	10.40	11.60	108.80
5	Burned oyster shell...	9.5	12.3	9.50	9.84	96.36
6	Raw oyster shell.....	6.1	14.4	6.10	11.52	82.68
7	Raw Limestone.....	6.7	14.2	6.70	11.36	85.64
8	Check, no lime.....	....	....	....	....	....
9	Burned limestone.....	9.4	8.6	9.40	6.88	83.92
10	Burned oyster shell...	6.7	6.4	6.70	5.12	60.68
11	Raw oyster shell.....	8.7	1.8	8.70	1.44	57.94
12	Raw limestone	2.3	6.5	2.30	5.20	34.60
13	Burned limestone	6.3	0.2	6.30	0.16	38.44
14	Burned oyster shell...	7.5	6.1	7.50	4.88	64.52
15	Check, no lime.....	....	....	....	....	....

An inspection of the last column of Table 5 will show that the application of lime has been highly profitable in every instance, but it is evident that the lighter applications have not been sufficient to satisfy the lime requirement of this soil. Plot 3, receiving an application of pulzerized raw limestone at the rate of 7900 pounds per acre, has given the highest total value of increase and the highest average increase for the six crops of wheat, while plot No. 4, receiving an equivalent amount of burned limestone, is second in total value of the increase and has given the highest average value per acre for the four crops of corn. Plot No. 5, receiving an equivalent amount of burned oyster shell, is third in the total value of the increase, and plot No. 2, receiving the pulverized raw oyster shell, takes fourth place.

A further summary of the results recorded in Table 5 brings out the following facts:

The average total increase for

(1) Pulverized raw oyster shell.....$78.43
(2) Burned oyster shell..... 73.85
(3) Pulverized raw limestone..... 77.60
(4) Burned limestone 77.05

From these results it is evident, therefore, that there is little room for choice between the different forms of lime so far as the matter of yield is concerned.

Ridgely Field.

In 1917 work was started at Ridgely, Caroline County, for the purpose of determining the relative value of different forms of lime for alfalfa. The plots were located on a fairly fertile loam soil of the Sassafras type and laid out in duplicate. Each plot was 40 feet by 45 feet, and contained approximately one twenty-fourth of an acre. The land was plowed early in the spring and the lime worked into the surface during the preparation of the seed bed. The alfalfa, which was seeded in April with oats as a nurse crop, failed to produce a good stand. As a result of the failure of the alfalfa the land was planted to soybeans in the spring of 1918, and after harvesting the soybeans the field was again seeded to alfalfa in the fall. This seeding resulted in a good stand, from which four cuttings were made during the season of 1919, and three cuttings the following year.

Table 6 shows the treatment of the plots and the total yield of the four cuttings of alfalfa secured from each plot in 1919 and the three cuttings made during the season of 1920.

Table 6.

THE EFFECT OF DIFFERENT FORMS OF LIME UPON THE YIELD OF ALFALFA HAY.

(Ridgely Field.)

Plot Treatment.	*Rate of Application, lbs.*	*Total Yield in Tons.*				*Average for Two Seasons (tons).*
		Series A		Series B		
		1919.	1920.	1919.	1920.	
Pulverized raw limestone....	4000	5.20	4.66	4.02	4.00	4.47
Pulverized raw oyster shell.	4000	4.52	2.60	4.24	4.29	3.91
Burned limestone	2000	3.37	3.24	3.32	3.09	3.26
Hydrated lime	3000	3.69	3.69	4.14	3.21	3.68

From table 6 it will be seen that the different treatment have given very consistent results with the exception of series A for 1920. From the averages given in the last column it will be seen that the raw pulverized limestone has given the highest yield of alfalfa, while the raw oyster shell lime holds second place. Burned limestone has produced the lowest average yield, while the hydrated form occupies a position intermediate between the burned and the raw lime. The center columns give the total yields of duplicate plots for the two seasons. Attention is called to the fact that the raw limestone and the pulverized oyster shell may have gained in effectiveness by virtue of the fact that all of the applications were made a year in advance of the date of seeding the alfalfa.

HAVE YOUR SOIL TESTED.

If your soil is needing lime you should know it and supply the need. If, on the other hand, the lime requirement of your soil has been met, you should know it and invest your money in fertilizers rather than in additional amounts of lime.

Your are invited to send a sample of your soil to the Experiment Station for a lime requirement test. This service is free.

Directions for Taking Soil Samples.

With a spade or shovel dig a square hole to the depth of about six inches, lay a piece of clean paper in the bottom of the hole and then shave a thin slice from one side of the hole, allowing the soil to fall on the paper. Lift the paper and soil slice from the hole and proceed to another place in the same field and repeat the operation.

If the field is small and fairly uniform two holes will be sufficient to give a representative sample, but if the field is large and uneven it will be better to secure samples from at least four different places. The samples thus secured from different places in the same field should then be mixed together, and from the mixture a half pint of soil should be taken for the test. This half-pint sample should be wrapped in paper or put in a clean bag and numbered or marked on the outside of the package. The samples from each field should be wrapped and numbered separately, then all packed together in a box or package for shipment.

The following information should accompany each sample:

(1) Location of the farm.
(2) Size of the field.
(3) When was lime last applied?
(4) Amount of lime used.
(5) Does clover grow well on this field?

Send your package by parcels post or by express, directed to:

THE SOILS DEPARTMENT, MARYLAND EXPERIMENT STATION,

COLLEGE PARK, MARYLAND.

UNIVERSITY OF MARYLAND

AGRICULTURAL EXPERIMENT STATION

Bulletin No. 243. April, 1921

WORK OF THE SEED INSPECTION LABORATORY FOR THE YEAR 1920.

By F. S. Holmes.*

INTRODUCTION

In effect the Maryland Seed Law provides that seed dealers may offer agricultural seeds of any quality for sale provided they are tagged as required. If accurate, the required information will indicate the real quality of the seeds. The purchaser may then decide for himself whether the quality is one he wants. In the great majority of cases he must accept the statements of the tag on faith. The chief purpose of the present work of the Seed Inspection Laboratory is to determine how closely various dealers selling seeds in the State

PERCENTAGE OF 1920 SAMPLES PROPERLY TAGGED AND FOUND TO BE AS REPRESENTED IN ALL RESPECTS.

Wm. G. Scarlett & Co	75.3
Atlantic Seed Co	75.0
J. Bolgiano & Son	69.4
Albert Dickinson Co	65.2
The W. A. Simpson Co	62.7
J. J. Buffington & Co	57.4
Blamberg Bros., Inc	57.1
H. W. Doughten, Inc	31.9
The Belt Seed Co	26.7
Cumberland Seed Co	24.0

live up to the statements on the tags of the seeds they sell. It is the purpose of this bulletin to present sufficient data to enable any one interested to form a definite and accurate opinion on this point for the year 1920.

Obviously it is unfair to pass judgment on a dealer on the basis of the showing of one lot of seeds—good or bad. In order to avoid falling into this all too common error, general summaries, covering a large number of samples, are used whenever possible. The great-

*The writer wishes to give due credit to Miss Anna M. Hook, Mrs. Clara R. Hodgins, Miss Caroline E. Veitch, and Miss Isabel C. Veitch for the careful and painstaking manner in which they made the purity analyses and the germination tests of the samples reported in this bulletin.

er the number of samples involved, the more trustworthy the conclusions that may be drawn from them. The standing of the ten wholesale dealers from whom the largest number of samples were taken during the year is shown by the insert on the preceding page. The differences brought out are so striking that no purchaser of seeds can be indifferent to them.

For several years previous to 1920 more samples were collected than the laboratory force was able to handle during the year. The result was that the work was several months behind at all times. Insomuch as the value of the results of the laboratory depend very largely on the timeliness with which they are placed in the hands of the interested persons, it was thought advisable to limit the number of samples collected during 1920. For this reason, only about 1200 samples were collected. This was 80 per cent. of the number collected in 1919. The work on this limited number of samples was finished in December, and the results were mailed to the interested persons late in January, 1921. The more important data of Table I were also given to the press of the State early in February.

INSPECTION OF TAGGING AND COLLECTION OF SAMPLES.

Lots of seed held by 203 retail dealers and consigned to 14 farmers were inspected at 116 points. Most of the State was covered in this work and the 1200 samples collected were representative of the seeds on the market in the spring and fall.

Of the lots of seed not mixtures inspected in 1920, 94 per cent. were tagged in accordance with the law; as compared with 92 per cent. in 1919. In 1919 only 35 per cent. of the wholesale dealers whose seeds were inspected had every lot properly tagged; while 48 per cent. of them met all the tagging requirements in 1920. Not one of the specified mixtures inspected in 1919 was properly tagged; in 1920 one lot was properly tagged, the other was not. Special mixtures were not even as well tagged in 1920 as they were in 1919. Only 46 per cent. of them were properly tagged in 1920; in 1919 63 per cent. of them met all the tagging requirements of the law.

In 1920, as in previous years, out-of-state dealers were more often offenders against the tagging requirements of the law than were Maryland dealers. Very few dealers are as careful as they should be in tagging the seeds they offer for sale. Ordinary carelessness seemed to be responsible for a large per cent. of the tagging violations.

In some cases, however, our work would seem to indicate that the omissions were intentional.

PURITY ANALYSES AND GERMINATION TESTS OF COLLECTED SAMPLES.

As in previous years, every effort has been made to insure the results of the Laboratory being accurate, and fair in every way to all concerned. Undoubtedly it is desireable that more lots of seed be inspected and more samples collected. Funds for travel and laboratory expenses are not available, however, and, until they are, more work can not be undertaken.

If the showing made by a dealer does not seem to be a good one —and this will be the case in many instances—it should be remembered that he has been given the benefit of every reasonable doubt and of the tolerance defined in Bulletin 220. Germination tests were made promptly. Samples collected in March and April were tested in May. Those found not to be within the "limits of tolerated variation" were retested in June. If the second test showed that they were still below the "limits of tolerated variation" they were retested the second time in July. Samples collected in August and September were tested the first time in September, and when necessary, were retested once or twice in October. A sample tested more than once was given the benefit of the highest test. A sample found not to be within the "limit of tolerated variation" for purity or weed seeds was analyzed two or more times, and the average of the analyses which agreed within the "limits of tolerated variation" among themselves was used as the "found" result. In addition to all these precautions, properly tagged lots of seed were not charged to wholesale dealers except when the samples were taken from what appeared to be original, unopened containers.

Samples of Seeds Not Mixtures

Our results for the 1120 samples of seeds not mixtures are summarized in Tables I, II, and III. The first one applies to wholesale dealers and is of general interest. The insert on the first page of this bulletin is taken from this table. This brief summary gives the gist of our results for the year. The second table applies to retail dealers and is of local interest. The third table groups the retail dealers of the various counties from which samples were collected.

Table VI may well be considered in connection with table I. Five of the largest wholesale dealers of Table I also appear in Table

VI. Some dealers that appear to be of little importance in Table I will be found to be large retail dealers in Table II.

A detailed report of our results for each sample, such as was sent in January to the persons and firms directly concerned, would unduly lengthen this bulletin. For this reason, only a summary for each retail dealer is given in Table II. On first thought, it may seem unfair to the retail dealer to report samples from seeds held by him as unsatisfactory, when he accepted them from the wholesale dealer in good faith. Nevertheless, he offers the seeds thus tagged to his customers who are entitled to this information regarding the seeds they purchase. The retail dealer who wishes to make a better showing for himself—the dealer who wants to furnish better seeds—should make his own purchases with more care. Table I of bulletin 238 and Table I of this bulletin may be advantageously consulted in this connection. Seeds that have been held over from a previous season should be retested for germination before they are again offered for sale.

TABLE I.

SUMMARY OF TAGGING AND PURITY ANALYSES OF SAMPLES OF SPECIAL MIXTURES OF SEEDS FOR WHOSE TAGGING THE WHOLESALE DEALER IS HELD RESPONSIBLE.

Wholesale Dealer.	Address.	Number of Samples.	Per Cent. Tagged in Accordance With the Law in All Respects.	Per Cent. Tagged in Accordance with the Law, and Found to be Within the Limits of Tolerated Variation, for:			
				Pure Seed, Weed Seeds and Germination.	Pure Seed.	Weed Seeds.	Germination.
Atlantic Seed Co.*	Philadelphia, Pa.	16	100.0	75.0	87.5	93.7	87.5
The Belt Seed Co.*	Baltimore, Md.	15	93.3	26.7	46.7	66.7	46.7
Blamberg Bros., Inc.*	Baltimore, Md.	56	100.0	57.1	69.6	91.1	87.5
J. Bolgiano & Son*	Baltimore, Md.	98	93.9	69.4	86.7	86.7	86.7
Herbert Bryant's Son	Alexandria, Va.	3	100.0	66.7	66.7	100.0	100.0
T. J. Buffington & Co.*	Baltimore, Md.	136	98.5	57.4	73.5	77.9	81.6
E .W. Conklin & Son	Binghamton, N. Y.	1	100.0	100.0	100.0	100.0	100.0
Continental Seed Co	Chicago, Ill.	2	100.0	100.0	100.0	100.0	100.0
Craver-Dickinson Seed Co	Buffalo, N. Y.	1	0.0	0.0	0.0	0.0	100.0
Cumberland Seed Co.*	Cumberland, Md.	25	100.0	24.0	32.0	44.0	72.0
Albert Dickinson Co.*	Chicago, Ill.	23	78.3	65.2	95.7	73.9	87.0
H. W. Doughten, Inc.*	New York, N. Y.	47	59.6	31.9	63.8	74.5	48.9
Dudley & Carpenter	Baltimore, Md.	2	0.0	0.0	0.0	0.0	0.0
Fred. Co. Farmers' Exchange	Frederick, Md.	4	50.0	50.0	100.0	50.0	75.0
Griffith & Turner Co	Baltimore, Md.	1	100.0	100.0	100.0	100.0	100.0
P. L. Hargett & Co., Inc	Frederick, Md.	1	100.0	0.0	0.0	0.0	0.0
A. H. Hoffman, Inc	Landisville, Pa.	6	0.0	0.0	0.0	0.0	0.0
Illinois Seed Co	Chicago, Ill.	7	100.0	42.9	42.9	100.0	100.0
C. A. King & Co	Toledo, Ohio	2	100.0	100.0	100.0	100.0	100.0
Nungesser-Dickinson Seed Co	New York, N. Y.	1	0.0	0.0	0.0	0.0	0.0
Philadelphia Seed Co	Philadelphia, Pa.	1	0.0	0.0	100.0	0.0	100.0
. L. Radwaner Seed Co	New York, N. Y.	1	0.0	0.0	0.0	0.0	0.0
. A. Salzer Seed Co	La Crosse, Wis.	1	0.0	0.0	0.0	0.0	0.0
Vm. G. Scarlett & Co.*	Baltimore, Md.	89	100.0	75.3	87.6	89.9	91.0
Schindel, Rohrer & Co	Hagerstown, Md.	1	100.0	0.0	0.0	0.0	100.0
The W. A. Simpson Co.*	Baltimore, Md.	75	97.3	62.7	80.0	90.7	85.3
. W. Wood & Sons	Richmond, Va.	1	100.0	100.0	100.0	100.0	100.0
Retail Dealers	Throughout Md.	504	96.6	47.4	68.5	76.2	70.0
All Samples Analyzed		1120	94.0	53.3	71.9	78.6	75.7

*The ten wholesaledealers marked with an arterisk (*) supply ninety per cent. of the seed sold by retail dealers of Maryland.

TABLE II.

SUMMARY OF TAGGING, PURITY ANALYSES AND GERMINATION TESTS OF SAMPLES OF SEEDS NOT MIXTURES AS HELD BY RETAIL DEALERS.

Place of Collection.	Name of Retail Dealer.	Number of Samples.	Per Cent. Tagged in Accordance With the Law in All Respects.	Per Cent. Tagged in Accordance with the Law, and Found to be Within the Limits of Tolerated Variation, for:			
				Pure Seed, Weed Seeds and Germination.	Pure Seed.	Weed Seeds.	Germination.
ABERDEEN	Johnson Bros.	1	100.0	0.0	100.0	100.0	0.0
AIKIN	P. D. Clark	1	100.0	100.0	100.0	100.0	100.0
ANNAPOLIS	The H. B. Myers Co.	11	100.0	45.5	54.5	81.8	90.9
ANTIETAM	James Snyder	1	100.0	0.0	0.0	0.0	100.0
BALTIMORE Gay Street	Griffith & Turner Co.	10	100.0	50.0	80.0	70.0	80.0
Paca Street	Griffith & Turner Co.	32	100.0	43.8	75.0	71.9	65.6
	J. Manns & Co.	19	26.3	21.1	21.1	21.1	21.1
	The Meyer-Stisser Co.	6	100.0	16.7	33.3	50.0	50.0
	Wiseman-Downs Co.	12	100.0	33.3	50.0	66.7	66.7
BARCLAY	Phillips & Phillips	1	100.0	100.0	100.0	100.0	100.0
BARNESVILLE	Thomas & Co.	6	100.0	50.0	66.7	83.3	100.0
BARTON	Mowbray Bros.	1	100.0	0.0	0.0	100.0	0.0
BEL AIR	Boarman & Bradford	7	100.0	42.9	57.1	85.7	71.4
	McComas Bros.	10	100.0	50.0	90.0	80.0	70.0
BERLIN	Berlin Hdwe Co.	2	100.0	50.0	50.0	50.0	100.0
	J. M. Bratten	2	100.0	50.0	100.0	100.0	50.0
	R. C. Peters & Sons	2	100.0	0.0	50.0	50.0	50.0
BOONSBORO	M. T. Warrenfeltz & Sons	2	100.0	100.0	100.0	100.0	100.0
BRUNSWICK	S. W. George & Co.	5	100.0	80.0	80.0	80.0	100.0
	Swank & Son	4	100.0	25.0	25.0	100.0	100.0
BUCK LODGE	M. E. Wade	1	100.0	100.0	100.0	100.0	100.0
CAMBRIDGE	Gerlach & Anstine	11	100.0	54.5	54.5	90.9	72.7
	Herbert Heearn Hdwe. Co.	12	100.0	66.7	83.3	75.0	75.0
	Jones & Groff	8	100.0	50.0	62.5	87.5	75.0
	Olin LeCompte	17	100.0	52.9	70.6	76.5	76.5
CENTREVILLE	Forman & Mason	4	100.0	25.0	75.0	75.0	75.0
	G. D. Neavitt	2	100.0	0.0	50.0	100.0	50.0
	Wright & Lowe	4	100.0	75.0	100.0	75.0	100.0
CHESAPEAKE CITY	P. F. Conrey	3	100.0	66.7	66.7	100.0	100.0

Place of Collection.	Name of Retail Dealer.	Number of Samples.	Per Cent. Tagged in Accordance With the Law in All Respects.	Per Cent. Tagged in Accordance With the Law, and Found to be Within the Limits of Tolerated Variation, for:			
				Pure Seed, Weed Seeds and Germination.	Pure Seed.	Weed Seeds.	Germination.
CHESTERTOWN	Davis & Satterfield	15	100.0	53.3	66.7	80.0	93.3
	Massey & Killbourne	3	100.0	33.3	33.3	100.0	100.0
	C. F. Parks	8	100.0	37.5	62.5	75.0	62.5
CHURCH HILL	E. S. Valliant & Son	4	100.0	100.0	100.0	100.0	100.0
	H. E. Walls	17	100.0	58.8	82.4	94.1	76.5
CHURCHVILLE	Chesney & Co	3	100.0	66.7	66.7	66.7	100.0
COCKEYSVILLE	H. E. Bartleson & Co	10	90.0	50.0	60.0	80.0	60.0
COLORA	Colora Grain & Hay Co	9	100.0	55.6	77.8	88.9	77.8
CONOWINGO	C. A. Andrew	9	100.0	66.7	88.9	66.7	100.0
CUMBERLAND	J .H. Brinker & Bro	13	100.0	30.8	46.2	61.5	84.6
	W. T. Coulehan & Bro	11	100.0	27.3	36.4	63.6	72.7
	S. S. Fisher	2	100.0	0.0	50.0	50.0	50.0
Baltimore Street	Flintstone Hdwe. Co	7	100.0	14.3	42.9	57.1	71.4
Liberty Street	Flintstone Hdwe. Co	13	100.0	46.2	61.5	69.2	76.9
	Jones & Lashley Hdwe. Co	1	100.0	0.0	0.0	0.0	100.0
	The Kenneweg Co	2	100.0	0.0	0.0	50.0	50.0
DAMASCUS	W. R. Fairchild	1	100.0	100.0	100.0	100.0	100.0
DENTON	Farmers Supply Co	3	100.0	33.3	33.3	33.3	100.0
	Nuttle Hdwe. Co	10	100.0	80.0	90.0	100.0	90.0
	Smith & Walls	12	100.0	75.0	91.7	75.0	100.0
DICKERSON	Mercer Jones & Son	3	100.0	100.0	100.0	100.0	100.0
DUBLIN	Nelson McCann	3	100.0	33.3	33.3	66.7	100.0
E. NEW MARKET	Saxton & Parker	5	100.0	60.0	80.0	80.0	80.0
	P. L. Willis	1	100.0	0.0	100.0	100.0	100.0
EASTON	Nevius & Frampton	6	100.0	83.3	100.0	83.3	100.0
	Shannahan & Wrightson Hdwe. Co.	9	100.0	55.6	55.6	100.0	88.9
	N. Tuthill & Son	14	100.0	78.6	85.7	85.7	92.9
ELKTON	Evans Bros	2	100.0	0.0	50.0	100.0	0.0
	R. B. Frazer	1	100.0	0.0	100.0	0.0	0.0
	Keys & Miller Lumber Co	2	100.0	100.0	100.0	100.0	100.0
ELLICOTT CITY	J. L. Clark	16	100.0	68.8	87.5	87.5	87.5

Place of Collection.	Name of Retail Dealer.	Number of Samples.	Per Cent. Tagged in Accordance With the Law in All Respects.	Per Cent. Tagged in Accordance With the Law, and Found to be Within the Limits of Tolerated Variation, for:			
				Pure Seed, Weed Seeds and Germination.	Pure Seed.	Weed Seeds.	Germination.
ELLICOTT CITY	W. R. Dorsey	8	100.0	50.0	87.5	62.5	87.5
	E. A. Talbott	5	100.0	40.0	40.0	80.0	80.0
EMMITSBURG	E. L. Frizell	8	100.0	37.5	75.0	87.5	75.0
FEDERALSBURG	Boyle Bros	6	100.0	33.3	50.0	50.0	66.7
	Covey & Williams	4	100.0	50.0	50.0	100.0	100.0
	Dean & Dean	8	100.0	50.0	50.0	87.5	75.0
	J. W. Hurlock & Co	8	100.0	25.0	50.0	75.0	62.5
	J. A. Hyland	8	100.0	62.5	75.0	100.0	87.5
FOREST HILL	E. Tucker & Co	4	100.0	25.0	50.0	75.0	50.0
	C. H. Wilson	5	100.0	40.0	40.0	100.0	80.0
FREDERICK	Fred. Co. Farmers Exchange	6	100.0	100.0	100.0	100.0	100.0
	P. L. Hargett & Co	13	100.0	69.2	84.6	92.3	76.9
	A. G. Quynn & Co	12	100.0	50.0	75.0	91.7	83.3
	Thomas & Co	8	100.0	62.5	75.0	87.5	87.5
FREELAND	S. B. Miller	1	100.0	100.0	100.0	100.0	100.0
	J. E. Shaver & Co	1	100.0	100.0	100.0	100.0	100.0
FROSTBURG	E. B. Prichard & Co	7	100.0	42.9	57.1	57.1	85.7
GAITHERSBURG	H. H. Griffith & Co	1	100.0	100.0	100.0	100.0	100.0
	Thomas & Co	9	100	66.7	77.8	77.8	100.0
GALENA	The Davis Co	2	100.0	50.0	50.0	100.0	100.0
GERMANTOWN	C. T. Johnson	7	100.0	71.4	71.4	71.4	100.0
GOLDSBORO	W. T. Jarman & Bro	1	100.0	100.0	100.0	100.0	100.0
	J. F. Lane	5	100.0	60.0	100.0	80.0	60.0
	W. J. Murphy	6	100.0	50.0	50.0	83.3	66.7
GORTNER	W. E. Spoerlin	2	100.0	50.0	50.0	100.0	100.0
GRACEHAM	L. B. Nicodemus	2	100.0	50.0	100.0	50.0	100.0
GRANTSVILLE	J. J. Bender	3	100.0	33.3	33.3	33.3	66.7
	U. M. Stanton	2	100.0	50.0	50.0	50.0	100.0
GREENMOUNT	J. A. DeHoff	1	100.0	100.0	100.0	100.0	100.0
GREENSBORO	C. B. Jarman	2	100.0	50.0	100.0	50.0	100.0
	Mrs. Gertrude Longfellow	1	100.0	0.0	0.0	0.0	100.0

Place of Collection.	Name of Retail Dealer.	Number of Samples.	Per Cent. Tagged in Accordance With the Law in All Respects.	Per Cent. Tagged in Accordance with the Law, and Found to be Within the Limits of Tolerated Variation, for:			
				Pure Seed, Weed Seed and Germination.	Pure Seeds.	Weed Seeds.	Germination.
HAGERSTOWN	Emmert Hdwe. Co.	14	100.0	28.6	42.9	71.4	78.6
	C. M. Horst	11	100.0	72.7	90.9	72.7	100.0
	E. W. Miller	5	100.0	80.0	80.0	80.0	80.0
	H. S. Myers	5	100.0	60.0	60.0	60.0	100.0
	Schindel, Rohrer & Co.	5	100.0	60.0	60.0	80.0	100.0
HAMPSTEAD	Rhoten & Leister	7	100.0	57.1	71.4	100.0	71.4
	P. A. Rinaman	6	100.0	50.0	100.0	100.0	50.0
HANCOCK	Anthony & Co.	1	100.0	100.0	100.0	100.0	100.0
	S. R. Cohill	1	100.0	0.0	100.0	100.0	0.0
	H. F. Exline	3	100.0	66.7	66.7	100.0	100.0
	P. T. Little	1	100.0	100.0	100.0	100.0	100.0
HARMONY GROVE	D. C. Ramsburg & Son	1	100.0	100.0	100.0	100.0	100.0
HILLSBORO	Charles Jarrell	5	100.0	60.0	80.0	80.0	80.0
HOODS MILL	Mullican & Hood	5	100.0	60.0	80.0	100.0	80.0
HURLOCK	W. C. Bradley & Son	14	100.0	35.7	64.3	78.6	64.3
	Wright Hdwe. Co.	2	100.0	100.0	100.0	100.0	100.0
HYATTSTOWN	Dudrow & Darby	1	100.0	100.0	100.0	100.0	100.0
	E. F. Harris	1	100.0	100.0	100.0	100.0	100.0
JEFFERSON	R. L. Shaff	1	100.0	100.0	100.0	100.0	100.0
	C. E. & H. C. Summers	1	100.0	100.0	100.0	100.0	100.0
KENNEDYVILLE	H. K. Zimmerman	1	100.0	0.0	100.0	100.0	0.0
KENNEDYSVILLE	Shafer, Redmile & Co.	1	100.0	0.0	100.0	100.0	0.0
KEYMAR	W. F. Cover & Son	1	100.0	100.0	100.0	100.0	100.0
LAUREL	Athey & Harrison	7	100.0	71.4	71.4	100.0	100.0
	G. W. Waters Co.	12	100.0	66.7	75.0	100.0	91.7
LESLIE	C. A. Benjamin & Co.	1	100.0	100.0	100.0	100.0	100.0
LEWISTOWN	D. W. Snook	2	100.0	100.0	100.0	100.0	100.0
LINWOOD	J. A. Englar	2	100.0	50.0	100.0	50.0	100.0
	Linwood Elevator Co.	2	100.0	100.0	100.0	100.0	100.0
LONACONING	L. Durst & Son	1	100.0	0.0	0.0	0.0	0.0
	J. M. Sloan & Son	1	100.0	100.0	100.0	100.0	100.0

Place of Collection.	Name of Retail Dealer.	Number of Samples.	Per Cent. Tagged in Accordance With the Law in All Respects.	Per Cent. Tagged in Accordance with the Law, and Found to be Within the Limits of Tolerated Variation, for:			
				Pure Seed, Weed Seed and Germination.	Pure Seed.	Weed Seeds.	Germination.
MARDELA SPRINGS	Mardela Hdwe. Co.	4	100.0	25.0	75.0	75.0	25.0
MARION STATION	Arzah Davis	4	100.0	50.0	75.0	75.0	75.0
MARYDEL	J. T. Heather	4	100.0	75.0	100.0	75.0	75.0
MASSEY	A. F. Huey	2	100.0	100.0	100.0	100.0	100.0
MEDFORD	Medford Grocery Co.	8	100.0	87.5	100.0	87.5	100.0
MIDDLEBURG	Thomas & Co.	1	100.0	0.0	0.0	100.0	100.0
MIDDLETOWN	D. V. Beachly & Bro.	1	100.0	100.0	100.0	100.0	100.0
	Valley Supply Co.	5	100.0	80.0	100.0	80.0	100.0
MILLINGTON	Paul Comegys	3	100.0	0.0	66.7	66.7	33.3
MONKTON	L. B. Bishop	1	100.0	0.0	0.0	0.0	100.0
MT. AIRY	B. S. Dorsey Co.	8	100.0	50.0	87.5	50.0	75.0
	C. A. Fleming	4	100.0	100.0	100.0	100.0	100.0
	W. H. & C. R. Hood	4	100.0	75.0	75.0	100.0	100.0
	Piedmont-Mt. Airy Guano Co.	1	100.0	0.0	100.0	100.0	0.0
MT. LAKE PARK	Harvey & Ream	3	100.0	33.3	100.0	66.7	66.7
MYERSVILLE	Farmers Mutual Exchange	2	100.0	100.0	100.0	100.0	100.0
	Myersville Supply Co.	7	100.0	71.4	100.0	85.7	85.7
NEW MIDWAY	S. J. Grimm	1	100.0	100.0	100.0	100.0	100.0
NEW WINDSOR	Devilbiss Bros.	6	100.0	66.7	83.3	83.3	83.3
	D. P. Smelser & Son	4	100.0	75.0	75.0	100.0	75.0
OAKLAND	D. M. Dixon & Son	6	100.0	33.3	50.0	66.7	50.0
	D. E. Offutt & Son	4	100.0	50.0	100.0	75.0	75.0
PARKTON	Parkton Farmers Supply Co.	3	100.0	66.7	66.7	66.7	100.0
PERRYMAN	W. C. Holloway	3	100.0	66.7	100.0	100.0	66.7
	Johnson Bros.	1	100.0	0.0	100.0	100.0	0.0
POCOMOKE CITY	N. Davis & Sons	7	100.0	71.4	71.4	100.0	100.0
	Lloyd & Blaine	4	100.0	50.0	75.0	100.0	75.0
	Peninsula Produce Exchange	30	100.0	53.3	76.7	76.7	83.3
PRESTON	J. L. Covey & Bro.	4	100.0	50.0	75.0	75.0	50.0
	J. A. Cox	6	100.0	66.7	83.3	100.0	66.7

Place of Collection.	Name of Retail Dealer.	Number of Samples.	Per Cent. Tagged in Accordance With the Law in All Respects.	Per Cent. Tagged in Accordance With the Law, and Found to be Within the Limits of Tolerated Variation, for:			
				Pure Seed, Weed Seeds and Germination.	Pure Seed.	Weed Seeds.	Germination.
	Preston Hdwe. & Auto Co.	4	100.0	75.0	75.0	100.0	100.0
PRICES	W. J. Massey	8	100.0	50.0	75.0	87.5	62.5
PRINCESS ANNE	C. H. Hayman	3	100.0	66.7	66.7	100.0	66.7
	W. P. Todd	10	100.0	70.0	80.0	70.0	80.0
PROVIDENCE	G. W. Biles Co	9	100.0	55.6	66.7	100.0	77.8
PYLESVILLE	Harford Farmers Supply Co	5	100.0	40.0	40.0	80.0	100.0
QUEEN ANNE	G. L. Jump Hdwe. & Impl. Co.	6	100.0	50.0	83.3	100.0	50.0
REISTERSTOWN	L. C. Caltrider	2	100.0	50.0	100.0	100.0	50.0
RIDGELY	J. W. Simon	5	100.0	20.0	80.0	100.0	40.0
RISING SUN	Biles & Cameron	15	100.0	66.7	86.7	86.7	80.0
	Stewart M. Ward Co.	9	100.0	77.8	88.9	100.0	88.9
ROCKVILLE	Holland & Clark	11	100.0	63.6	100.0	90.9	72.7
	W. W. Welch Estate	1	100.0	100.0	100.0	100.0	100.0
ROCKY RIDGE	Rocky Ridge Elevator Co.	4	100.0	75.0	75.0	75.0	100.0
SALISBURY	Dorman & Smyth Hdwe. Co.	12	100.0	41.7	83.3	58.3	66.7
	Farmers & Planters Co.	1	100.0	100.0	100.0	100.0	100.0
	L. W. Gunby Co.	1	100.0	0.0	100.0	0.0	0.0
	Mitchell & Goslee Hdwe. Co.	4	100.0	25.0	25.0	50.0	50.0
SANDY BOTTOM	A. Cohen	2	100.0	100.0	100.0	100.0	100.0
SELLMAN	W. W. Darby	1	100.0	100.0	100.0	100.0	100.0
SHARPTOWN	J. P. Cooper & Co.	1	100.0	0.0	0.0	100.0	0.0
SMITHSBURG	J. T. Towson & Son	2	100.0	0.0	0.0	100.0	50.0
SNOW HILL	W. T. Cherrix	2	100.0	0.0	100.0	100.0	0.0
	C. S. Timmons	7	100.0	57.1	57.1	71.4	100.0
SPARKS	S. G. Sparks & Co.	3	100.0	100.0	100.0	100.0	100.0
STILL POND	Wm. Medders & Co.	6	100.0	16.7	83.3	50.0	66.7
STREET	Orr & Oldfield	6	100.0	66.7	83.3	83.3	83.3
SUDLERSVILLE	J. T. Nickerson	2	100.0	50.0	50.0	100.0	50.0
	W. D. Roe & Son	3	100.0	66.7	100.0	66.7	66.7
	Wallace & Baxter	2	100.0	50.0	50.0	50.0	100.0

Place of Collection.	Name of Retail Dealer.	Number of Samples.	Per Cent. Tagged in Accordance With the Law in All Respects.	Per Cent. Tagged in Accordance With the Law, and Found to be Within the Limits of Tolerated Variation, for:			
				Pure Seed, Weed Seeds and Germination.	Pure Seed.	Weed Seeds.	Germination.
SYKESVILLE	H. R. De Vries	3	100.0	66.7	66.7	66.7	100.0
	Md. Milling & Supply Co	15	100.0	60.0	86.7	100.0	66.7
TANEYTOWN	The Reindollar Co	7	100.0	57.1	71.4	100.0	85.7
	Taneytown Grain & Supply Co	6	100.0	66.7	83.3	83.3	100.0
THURMONT	G. W. Stocksdale & Co	1	100.0	100.0	100.0	100.0	100.0
	O. S. Weybright	11	100.0	36.4	63.6	72.7	72.7
TRAPPE	Nevius Bros	2	100.0	100.0	100.0	100.0	100.0
	D. T. Simpson & Son	5	100.0	40.0	100.0	80.0	40.
UNION BRIDGE	C. E. Engel & Co	1	100.0	100.0	100.0	100.0	100.0
	Farmers Exchange Co	2	100.0	100.0	100.0	100.0	100.0
	Thomas & Co	3	100.0	66.7	66.7	100.0	100.0
VIENNA	G. W. Millard	1	100.0	0.0	100.0	100.0	0.0
WALKERSVILLE	J. H. Jamison	8	100.0	25.0	75.0	87.5	50.0
	J. H. Stauffer	2	100.0	100.0	100.0	100.0	100.0
WESTERNPORT	Westernport Mercantile Co	1	100.0	100.0	100.0	100.0	100.0
WESTMINSTER	Farmers Fertilizer & Feed Co	9	100.0	77.8	77.8	100.0	100.0
	Farmers Supply Co	28	100.0	57.1	75.0	89.3	71.4
WHALEYSVILLE	Wimbrow Bros	2	100.0	50.0	50.0	100.0	100.0
WHITE HALL	W. N. Krout	1	100.0	100.0	100.0	100.0	100.0
WOODBINE	J. M. DeLashmutt & Son	11	100.0	45.5	72.7	63.6	72.7
WOODSBORO	Miller & Cramer	3	100.0	66.7	100.0	100.0	66.7
THROUGHOUT MD.	Twelve (12) Consignees	21	42.9	19.0	28.6	33.3	38.1

Table III has been prepared with the idea of showing how the seeds sold in various counties compare with one another. It appears from this table that there are wide variations among the twenty counties from which samples were collected. The extreme variation for samples properly tagged and found to be as represented in all respects is from approximately 32 per cent. in Allegany County to 72 per cent. in Montgomery County. Undoubtedly some counties are more alive to the importance of good seeds than others. Officials of county farmers' organizations may well give Table III their careful consideration.

TABLE III.

SUMMARY OF TAGGING, PURITY ANALYSES AND GERMINATION TESTS OF SAMPLES OF SEEDS NOT MIXTURES AS HELD BY RETAIL DEALERS OF VARIOUS COUNTIES.

County.	Number of Places.	Number of Dealers.	Number of Samples.	Per Cent Tagged in Accordance With the Law in All Respects.	Per Cent. Tagged in Accordance with the Law, and Found to be Within the Limits of Tolerated Variation, for:			
					Pure Seed, Weed Seeds and Germination.	Pure Seed.	Weed Seeds.	Germination.
LLEGANY	5	12	60	100.0	31.7	46.7	61.7	76.7
NNE ARUNDEL	1	1	11	100.0	45.5	54.5	81.8	90.9
ALTIMORE (Including the city)	8	13	101	85.1	41.6	59.4	62.4	60.4
AROLINE	8	18	96	100.0	57.3	74.0	84.4	78.1
ARROLL	14	25	145	100.0	64.1	81.4	89.0	80.7
ECIL	8	11	61	100.0	63.9	83.6	88.5	82.0
ORCHESTER	4	9	71	100.0	52.1	83.1	81.7	71.8
REDERICK	14	24	114	100.0	59.6	79.8	86.0	83.3
ARRETT	4	6	20	100.0	40.0	55.0	65.0	70.0
ARFORD	8	11	48	100.0	45.8	66.7	83.3	75.0
OWARD	1	3	29	100.0	58.6	79.3	79.3	86.2
ENT	7	9	42	100.0	42.9	69.0	78.6	78.6
ONTGOMERY	9	12	43	100.0	72.1	86.0	86.0	93.0
RINCE GEORGES	1	2	19	100.0	68.4	73.7	100.0	94.7
UEEN ANNES	6	11	53	100.0	56.6	81.1	88.7	73.6
OMERSET	2	3	17	100.0	64.7	76.5	76.5	76.5
ALBOT	2	5	36	100.0	69.4	83.3	88.9	86.1
ASHINGTON	6	13	52	100.0	55.8	65.4	76.9	88.5
ICOMICO	3	6	23	100.0	34.8	69.6	60.9	52.2
ORCESTER	4	9	58	100.0	51.7	72.4	81.0	82.8
onsignees in all Maryland	..	12	21	42.9	19.0	28.6	33.3	38.1
l Dealers and Consigneees	115	215	1120	97.5	53.9	72.6	79.8	77.5

Samples of Specified Mixtures.

The results of our purity analyses and germination tests of the two samples of specified mixtures collected during the year are given in Table IV. It speaks for itself. Why farmers should demand mixtures that can be made up so easily is not apparent. The number of samples collected indicate that such mixtures are not widely used.

TABLE IV.

RECORD OF TAGGING, PURITY ANALYSES AND GERMINATION TESTS OF SAMPLES OF SPECIFIED MIXTURES OF SEEDS.

L T V—LIMIT OF TOLERATED VARIATION. N-G—NOT GIVEN.

Laboratory Number.	Place of Collection. Vendor (or Consignee-c). Tagger.	Kind of Mixture.		Per Cent. of Pure Seed.	Per Cent. of Weed Seeds.	Per Cent. of Germination	Tested for Germination.
200486	OAKLAND D. M. Dixon & Co..... **Cumberland Seed Co.**	Timothy.....	Given L T V Found	73.50 68.00 83.20	2.00 2.50 1.82	95.00 89.00 **63.00**	Jan. 20 May 20
		alsike clover.....	Given L T V Found	18.55 14.64 **2.37**		85.00 78.00 ....*	Jan. 20
200154	SINGERLY J. T. Murray-c **P. L. Rohrer**	red clover..... (mammoth)	Given L T V Found	**n-g**	**n-g**	**n-g**	**n-g n-g**
				65.86	0.73	89.00	May 20
		alsike clover.....	Given L T V Found	**n-g** 31.82		**n-g** 82.50	**n-g n-g** May 20

*Not enough alsike clover for a germination test.

Samples of Special Mixtures.

The usual number of samples of special mixtures were collected during the year. Our results are reported in detail in Table V and are summarized in Table VI. The samples collected in 1920 do not make even as good a showing as those collected in 1919 and reported in bulletin 238. The same tolerance which was applied to other samples was also applied to samples of special mixures. A kind of seed "given" as present in the mixture in the proportion of 5.00 per cent. was so considered if 3.80 per cent. was "found." A kind of seed not mentioned as present in the mixture in the proportion of 5.00 per cent. was not considered to be there in that proportion unless 6.10 per cent., or more, was "found." The different kinds of seeds found in each sample, in the proportion of five per cent., or more, are arranged in the order of the proportion of each present, the kind in the largest proportion first.

The city man may be justified in buying the small amount of such mixtures that is needed for a lawn. Why farmers should buy them is not plain. If they are needed, farmers can make them up themselves. Bluegrass and red top form the basis of the great majority of them. As Table V shows, there is nothing mysterious about these mixtures except that they can be sold to so many persons.

RECORD OF TAGGING AND PURITY ANALYSES OF SAMPLES OF SPECIAL MIXTURES OF SEEDS.

L T V—LIMIT OF TOLERATED VARIATION. N-G—NOT GIVEN.

Laboratory Number.	Place of Collection. Vendor (or consignee-c) Tagger.	Kinds Present in the Proportion of Five Per Cent. or More.			Per Cent. of	
		Given.	Found.		Weed Seeds.	Inert Matter.
0491	ANNAPOLIS The Henry B Myers Co..... **The W. A. Simpson Co.**	Red top Crt. dogstail Rye grass Blue grass	Red top Crt. dogstail Rye grass Blue grass	Given L T V Found	0.90 1.18 0.83	9.50 11.50 **22.05**
0701	BALTIMORE—Paca Street Griffith & Turner Co. **Griffith & Turner Co.**	Orchard grass Rye grass Blue grass Timothy Red top Alsike clover **White clover**	Orchard grass Rye grass Blue grass Timothy Red top Alsike clover	Given L T V Found	6.00 7.30 0.46	15.00 18.10 **20.25**
0702	BALTIMORE—Paca Street Griffith & Turner Co. **Griffith & Turner Co.**	Orchard grass Blue grass **White clover**	Orchard grass Blue grass	Given L T V Found	0.60 0.82 0.42	35.00 42.10 19.75
0703	BALTIMORE—Paca Street Griffith & Turner Co. **Griffith & Turner Co.**	Red top Blue grass Rye grass **White clover**	Red top Blue grass Rye grass	Given L T V Found	0.55 0.76 0.89	33.40 40.18 33.18
0750	BALTIMORE **J. Manns & Co.** **not given.**	**not given**	Blue grass Red top Timothy	Given L T V Found	**n-g** 1.35	**n-g** 17.62
0762	BALTIMORE Wiseman-Downs Co. Wiseman-Downs Co.	Blue grass Red clover Timothy	Blue grass Red clover Timothy	Given L T V Found	1.50 1.90 1.57	15.00 18.10 13.04
0187	BERLIN Berlin Hardware Co. **Berlin Hardware Co.**	Rye grass Blue grass	Rye grass **Red top** Blue grass	Given L T V Found	4.00 4.90 1.18	20.00 24.10 **30.84**
1021	CAMBRIDGE **Herbert Hearn Hdwe. Co.** **J. Bolgiano & Son.**	Blue grass Red top White clover **Rye grass**	Blue grass Red top White clover	Given L T V Found	0.90 1.18 **1.31**	**(15.00)** 18.10 **21.68**
0261	CAMBRIDGE Herbert Hearn Hdwe. Co. **J. J. Buffington & Co.**	Red top Blue grass Rye grass	Red top Blue grass Rye grass	Given L T V Found	0.73 0.98 **1.03**	6.64 8.07 **45.81**
1195	CENTREVILLE Wright & Lowe **Wright & Lowe**	Red top Blue grass Rye grass	Red top Blue grass Rye grass **Crt. dogstail**	Given L T V Found	0.90 1.18 0.82	9.50 11.50 **15.38**
0130	CHESTERTOWN C. F. Parks **C. F. Parks**	Timothy Alsike clover **Red clover**	Timothy Alsike clover	Given L T V Found	2.00 2.50 0.76	2.41 2.99 2.26
0403	COCKEYSVILLE **H. E. Bartleson & Co.** **J. Bolgiano & Son**	Red top Can. blue grass Ky. blue grass White clover	Red top Can. blue grass Ky. blue grass White clover	Given L T V Found	0.66 0.89 0.70	**(15.00)** 18.10 **28.11**
0919	COCKEYSVILLE **H. E. Bartleson & Co.** **The W. A. Simpson Co.**	**not given**	Red top Blue grass Rye grass Crt. dogstail	Given L T V Found	0.90 1.18 0.59	9.50 11.50 8.33
0404	COCKEYSVILLE H. E. Bartleson & Co. **H. E. Bartleson & Co.**	Rye grass Red top Blue grass	Rye grass Red top Blue grass **Red fescue**	Given L T V Found	2.00 2.50 0.77	18.00 21.70 21.64

Laboratory Number.	Place of Collection Vendor (or consignee-c) Tagger	Kinds Present in the Proportion of Five Per Cent. or More.		Per Cent. of		
		Given.	Found.		Weed Seeds.	Inert Matter
201106	DENTON Nuttle Hardware Co. **J. Bolgiano & Son**	**(Red top)** **(Can. bl. grass)** **(Ky. bl. grass)** **(White clover)**	Red top Can. blue grass Ky. blue grass White clover	Given L T V Found	**(1.50)** 1.90 0.65	**(28.00)** 33.70 12.59
201090	EASTON N. Tuthill & Son **J. J. Buffington & Co.**	Red top Rye grass Blue grass	Red top Rye grass Blue grass	Given L T V Found	0.73 0.98 **1.04**	6.64 8.07 **18.79**
200721	ELLICOTT CITY J. L. Clark **J. L. Clark**	Blue grass Red top Rye grass	Blue grass Red top Rye grass	Given L T V Found	0.73 0.98 0.73	6.64 8.07 **16.17**
200712	ELLICOTT CITY E. A. Talbott **J. Bolgiano & Son**	Blue grass Red top White clover	Blue grass Red top White clover	Given L T V Found	0.46 0.65 **0.80**	13.82 16.68 **20.59**
200571	FREDERICK A. G. Quynn & Co. **The W. A. Simpson Co.**	Timothy Blue grass Meadow fescue Tall fescue Rye grass Red fescue Crt. dogstail Red clover	**Red top** Timothy Blue grass Meadow fescue Tall fescue Rye grass Red fescue Crt. dogstail Red clover	Given L T V Found	1.15 1.48 **1.57**	15.95 19.24 **22.74**
200576	FREDERICK A. G. Quynn & Co. **The W. A. Simpson Co.**	Rye grass Blue grass Crt. dogstail Red top Timothy **Red clover** **Alsike clover**	Rye grass Blue grass Crt. dogstail Red top Timothy	Given L T V Found	0.75 1.00 **1.04**	15.12 18.24 **21.65**
200574	FREDERICK A. G. Quynn & Co. **A. G. Quynn & Co.**	Red top Blue grass Rye grass **White clover**	Red top Blue grass Rye grass	Given L T V Found	0.50 0.70 0.47	35.50 42.70 18.58
200003	HANCOCK Corona Orchard Co.-c **Wing Seed Co.**	Alfalfa Tall oat gr. Ky. blue grass Eng. rye grass Meadow fescue **Sweet clover**	Alfalfa Tall oat gr. Ky. blue grass Eng. rye grass Meadow fescue	Given L T V Found	12.53 15.16 **0.32**	56.35 65.18 9.59
200907	MOUNT AIRY B. S. Dorsey Co. **The W. A. Simpson Co.**	Red top Blue grass Crt. dogstail Meadow fescue Per rye grass	Red top Blue grass Crt. dogstail Meadow fescue Per. rye grass	Given L T V Found	0.60 0.82 0.71	7.25 8.80 **9.78**
200351	NEW WINDSOR D. P. Smelzer & Son **J. J. Buffington & Co.**	Timothy Meadow fescue Ital. rye grass	**Red top** **Blue grass** Timothy Meadow fescue Ital. rye grass	Given L T V Found	0.55 0.76 **1.10**	27.50 33.10 **33.49**
200205	POCOMOKE CITY Peni. Produce Exchange Peni. Produce Exchange	Timothy Red clover Per. rye grass Ital. rye grass Meadow fescue Red top Orchard grass Alsike clover	Timothy Red clover Per. rye grass Ital. rye grass Meadow fescue Red top Orchard grass Alsike clover	Given L T V Found	1.75 2.20 0.56	5.50 6.70 2.10

Laboratory Number.	Place of Collection. Vendor (or consignee-c) Tagger	Kinds Present in the Proportion of Five Per Cent. or More. Given.	Found.		Per Cent. of Weed Seeds	Inert Matter
200209	POCOMOKE CITY Peni. Produce Exchange **Peni. Produce Exchange**	Blue grass Red top Rye grass	Blue grass Red top Rye grass	Given L T V Found	1.58 2.00 0.92	7.90 9.58 **36.79**
201070	PRESTON Preston Hdwe. & Auto Co. **The W. A. Simpson Co.**	Red top Can. blue grass Ky. blue grass Meadow fescue Tall fescue Per. rye grass Crt. dogstail **Red fescue**	Red top Can. blue grass Ky .blue grass Meadow fescue Tall fescue Per. rye grass Crt. dogstail	Given L T V Found	2.80 3.46 **4.05**	6.90 8.38 **11.72**
201071	PRESTON Preston Hdwe. & Auto. Co. **The W A. Simpson Co.**	Timothy Red top Meadow fescue Tall fescue Rye grass Red clover Blue grass R. S. Meadow gr. Crt. dogstail	Timothy Red top Meadow fescue Tall fescue Rye grass Red clover Blue grass R. S. Meadow gr. Crt. dogstail	Given L T V Found	1.10 1.42 1.40	18.15 21.88 **21.97**
200184	SALISBURY Dorman & Smith Hdwe. Co. Dorman & Smith Hdwe. Co.	Rye grass Timothy Red top	Rye grass Timothy Red top	Given L T V Found	2.00 2.50 1.11	20.00 24.10 4.45
200980	SALISBURY L. W. Gunby & Co. J. Bolgiano & Son	Red top Can. blue grass Ky. blue grass White clover	Red top Can. blue grass Ky. blue grass White clover	Given L T V Found	0.66 0.89 0.69	16.80 20.26 16.18
200945	SNOW HILL W. T. Cherrix **Wm. G. Scarlett & Co.**	Rye grass Red top Blue grass **Crt. dogstail** **White clover**	Rye grass Red top Blue grass	Given L T V Found	1.95 2.44 0.88	16.55 19.96 12.32
200414	SYKESVILLE Md. Milling & Supply Co. **The W. A. Simpson Co.**	Meadow fescue Per. rye grass Red top Can. blue grass Ky. blue grass Crt. dogstail	Meadow fescue Per. rye grass Red top Can. blue grass Ky. blue grass Crt. dogstail	Given L T V Found	3.14 3.87 **6.96**	7.91 9.59 **10.83**
200888	SYKESVILLE Md. Milling & Supply Co. **The W. A. Simpson Co.**	Red top Blue grass Crt. dogstail Per. rye grass	Red top Blue grass Crt. dogstail Per. rye grass	Given L T V Found	0.90 1.18 0.65	9.50 11.50 8.81
200893	SYKESVILLE Md. Milling & Supply Co. **The W. A. Simpson Co.**	Blue grass Crt. dogstail Rye grass Timothy Red top **Alsike clover** **Red clover**	Blue grass Crt. dogstail Rye grass Timothy Red top	Given L T V Found	0.75 0.75 1.00 0.81	15.12 15.12 18.24 **19.95**
200356	UNION BRIDGE Thomas & Co. **J. J. Buffington & Co.**	Rye grass Red top **Blue grass**	Rye grass Red top	Given L T V Found	0.73 0.98 **1.08**	6.64 8.07 **51.14**
200323	WESTMINSTER Farmers Fert. & Feed Co. **Blamberg Bros.**	Timothy Red clover Red top Alsike clover Alfalfa	Timothy Red clover Red top Alsike clover Alfalfa	Given L T V Found	6.45 7.84 **4.39**	5.10 6.22 **7.00**
200327	WESTMINSTER Farmers Fert. & Feed Co. **Blamberg Bros.**	Timothy Red clover Red top Alsike clover **Orchard grass**	Timothy Red clover Red top Alsike clover	Given L V T Found	7.10 8.62 4.17	5.50 6.70 6.62

Laboratory Number.	Place of Collection. Vendor (or consignee-c) Tagger	Kinds Present in the Proportion of Five Per Cent. or More.		Per Cent. of		
		Given.	Found.		Weed Seeds.	Inert Matter
200328	WESTMINSTER Farmers Fert. & Feed Co. **J. J. Buffington & Co.**	**(Red top)** **(Rye grass)** **(Blue grass)**	Red top Rye grass Blue grass	Given L T V Found	0.10 0.22 **0.83**	5.73 6.98 **22.60**
200326	WESTMINSTER Farmers Fert. & Feed Co. Wm. G. Scarlett & Co.	Timothy Alfalfa Red clover Alsike clover	Timothy Alfalfa Red clover Alsike clover	Given L T V Found	4.70 5.74 4.03	11.76 14.21 10.56
200335	WESTMINSTER Farmers Supply Co. Wm. G. Scarlett & Co.	Timothy Alfalfa Red clover	Timothy Alfalfa Red clover	Given L T V Found	3.85 4.72 4.15	13.84 16.71 15.69
200336	WESTMINSTER Farmers Supply Co. Wm. G. Scarlett & Co.	Timothy Alfalfa Red clover Alsike clover	Timothy Alfalfa Red clover Alsike clover	Given L T V Found	4.70 5.74 5.08	11.76 14.21 11.25
200341	WESTMINSTER Farmers Supply Co. Wm. G. Scarlett & Co.	Rye grass Blue grass Red top Crt. dogstail White clover	Rye grass Blue grass Red top Crt. dogstail White clover	Given L T V Found	1.55 1.96 0.84	16.55 19.96 **29.71**
200614	WESTMINSTER Farmers Supply Co. Wm. G. Scarlett & Co.	Timothy Alfalfa Red clover **Orchard grass**	Timothy Alfalfa Red clover	Given L T V Found	4.28 5.24 3.99	11.71 14.15 11.44
200616	WESTMINSTER Farmers Supply Co. Wm. G. Scarlett & Co.	Hard fescue Timothy Blue grass Red top Crt. dogstail White clover	Hard fescue Timothy Blue grass Red top Crt. dogstail White clover	Given L T V Found	1.00 1.30 0.89	11.05 13.36 8.84

TABLE VI.

SUMMARY OF TAGGING AND PURITY ANALYSES OF SAMPLES OF SPECIAL MIXTURES OF SEEDS FOR WHOSE TAGGING THE WHOLESALE DEALER IS HELD RESPONSIBLE.

Name and Address of Wholesale Dealer.	Number of Samples.	Per Cent. Tagged in Accordance With the Law in All Respects.	Per Cent. Tagged in Accordance with the Law, and Found to be Within the Limits of Tolerated Variation, for:			
			All Kinds, Weed Seeds and Inert Matter.	All Kinds.	Weed Seeds.	Inert Matter.
Blamberg Bros., Baltimore	2	50.0	0.0	50.0	100.0	50.0
J. Bolgiano & Son, Baltimore	5	40.0	20.0	60.0	40.0	20.0
J. J. Buffington & Co., Baltimore	5	40.0	0.0	40.0	0.0	0.0
Wm. G. Scarlett & Co., Baltimore	7	71.4	57.1	71.4	100.0	85.7
The W. A. Simpson Co., Baltimore	10	50.0	10.0	50.0	60.0	20.0
The Wing Seed Co., Mechanicsburg, O.	1	0.0	0.0	0.0	100.0	100.0
Retailers Throughout Maryland	14	35.7	21.4	35.7	85.7	57.1
All Samples Analyzed	44	45.5	20.5	47.7	68.2	43.2

SAMPLES SUBMITTED TO THE LABORATORY.

The large number of samples submitted to the Laboratory by one firm in 1919 made it necessary to limit the number that would be handled free of charge for any firm or individual during a calendar year. The limit set (twelve purity analyses and germination tests, or twenty four of either) seems to have caused the number of samples to fall off from 821 in 1919 to 500 in 1920. It is noticeable from Table VII that while the work done for canners fell off materially, that done for farmers increased to a marked extent. Farmers submitted fewer samples than any other group in 1919, while in 1920 they submitted more than any other. The farmers of the State are becoming more and more aware of the value of the work of the Laboratory and each succeeding year finds them making greater use of its facilities.

TABLE VII.

SUMMARY OF WORK ON SAMPLES SUBMITTED TO THE LABORATORY IN 1919 AND 1920.

	Wholesale Dealers.		Retail Dealers.		Canners.		Farmers.		Exp. Sta. and College.		Total.	
	1919	1920	1919	1920	1919	1920	1919	1920	1919	1920	1919	1920
Samples submitted	172	139	160	124	291	46	90	154	92	37	821	500
Purity Analyses Made	143	91	148	95	1	6	35	64	0	1	327	257
Germination Tests Made	156	135	146	119	291	40	90	118	90	35	773	447
Identifications Made	0	0	0	0	0	2	4	8	0	0	4	10
Lots of Tobacco Seed Cleaned	0	0	0	0	0	0	12	30	2	2	14	32
Total Units of Work Done	299	226	294	214	292	48	141	220	92	38	1118	746

ONLY THE BULLETINS NAMED BELOW ARE AVAILABLE FOR DISTRIBUTION.

These Bulletins are sent free of charge to any address upon application.

EXPERIMENT STATION BULLETINS.

Bulletin No. 131, Nov., 1908, Treatment for San Jose Scale.
" " 142, Feb., 1910, The Codling Moth.
" " 147, Aug., 1910, Variety Tests of Wheat.
" " 155, Aug., 1911, Maryland Weeds and Other Harmful Plants.
" " 162, Dec., 1911, The Quality of Seed.
" " 163, Jan., 1912, Increasing the Durability of Fence Posts.
" " 164, Feb., 1912, Lime-Sulfur as a Summer Spray
" " 165, Feb., 1912, Boys' Corn Growing Contest.
" " 169, Aug., 1912, Cow Testing Associations.
" " 172, Jan., 1913, Irish Potato Investigations.
" " 174, Feb., 1913, Hog Cholera.
" " 175, Mar., 1913, Miscellaneous Insect Pests.
" " 176, Apr., 1913, The Peach-Tree Borer.
" " 177, May, 1913, Open Cow Stable.
" " 178, Oct., 1913, Apple Orchard Experiments.
" " 181, Mar., 1914, Inexpensive Aids in Producing Sanitary Milk.
" " 183, May, 1914, Study of Rest Period in Potato Tubers.
" " 187, Nov., 1914, Profitable and Unprofitable Cows.
" " 188, Dec., 1914, Types and Varieties of Maryland Tobacco.
" " 190, Feb., 1915, Relation of Catalase and Oxidases to Respiration in Plants.
" " 192, Jan., 1916, Internal Actions of Chemicals on Resistance of Tomatoes to Leaf Diseases.
" " 193, Feb., 1916, Tests of the Availability of Different Grades of Ground Limestone.
" " 194, Feb., 1916, Sudan Grass.
" " 195, Mar., 1916, Onions.
" " 196, Apr., 1916, Methods in Pear and Apple Breeding.
" " 200, Jan., 1917, Winter Oats, Barley, Spelt and Emmer.
" " 202, Feb., 1917, Timothy Fertilization and Culture.
" " 204, Mar., 1917, Variety Tests of Tomatoes, Potatoes, Cabbage and Other Vegetables.
" " 207, May, 1917, Plum Growing in Maryland.
" " 209, Dec., 1917, The Oriental Peach Pest.
" " 211, Feb., 1918, Strawberry Notes.
" " 214, Mar., 1918, Tests of An "All Crops" Soil Inoculum.
" " 218, June, 1918, Report of Nut Tree Investigations in Maryland.
" " 219, Sept., 1918, The Revised Agricultural Seed Law.
" " 220, Sept., 1918, Agricultural Seed Inspected in 1917.
" " 222, Sept., 1918, Experiments With Fertilizers on Greenhouse Crops.
" " 227, Mar., 1919, Citrus Fruit Rinds As a Hog Feed.
" " 228, July, 1919, Growing Alfalfa in Maryland.
" " 238, July, 1920, Seed Inspected in 1919.
" " 239, Oct., 1920, Geraninum Leaf Spot.
" " 240, Nov., 1920, Internal Fungous Parasites of Agricultural Seeds.
" " 241, Dec., 1920, Annotated List of Halticini.
" " 242, Jan., 1921, The Comparative Value of Different Forms of Lime.
" " 243, Apr., 1921, Work of the Seed Inspection Laboratory for the Year 1920.